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Light and Lighting

May 1961

Lighting has an important part to play in church interiors, in revealing, as here, form, colour and texture; guidance on its use in this way is one aspect of the new IES Code which is reviewed in detail in this issue.

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tungsten

lighting

fittings

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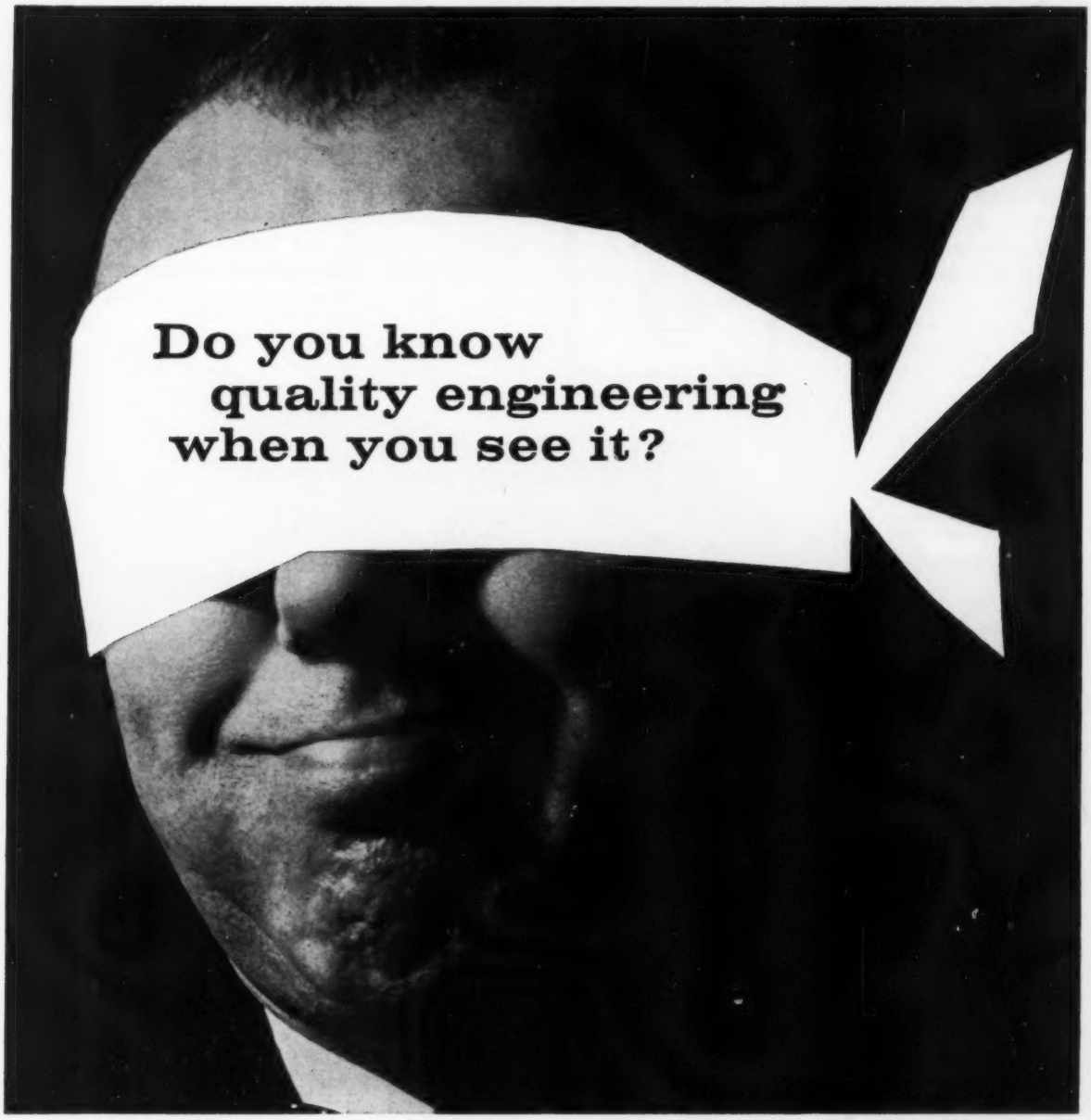

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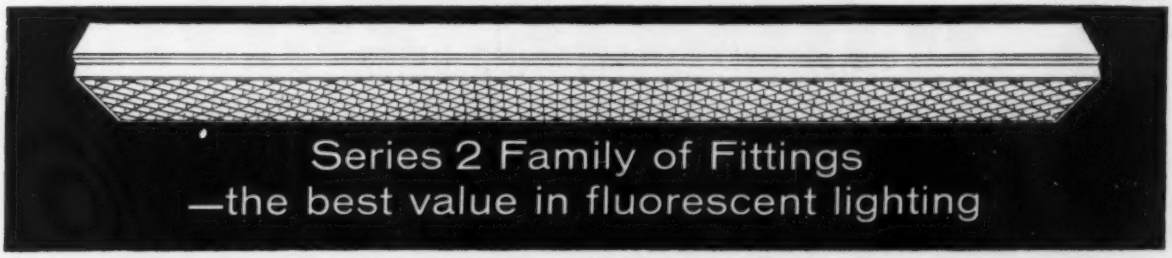

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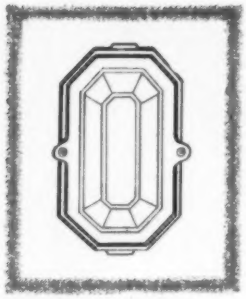
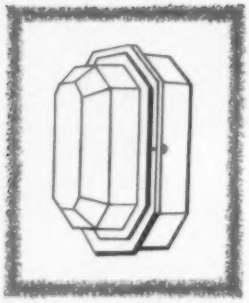


DETACHABLE COVER TYPE
for corners, cellars, arches.



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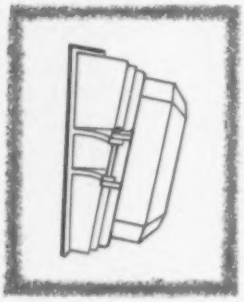

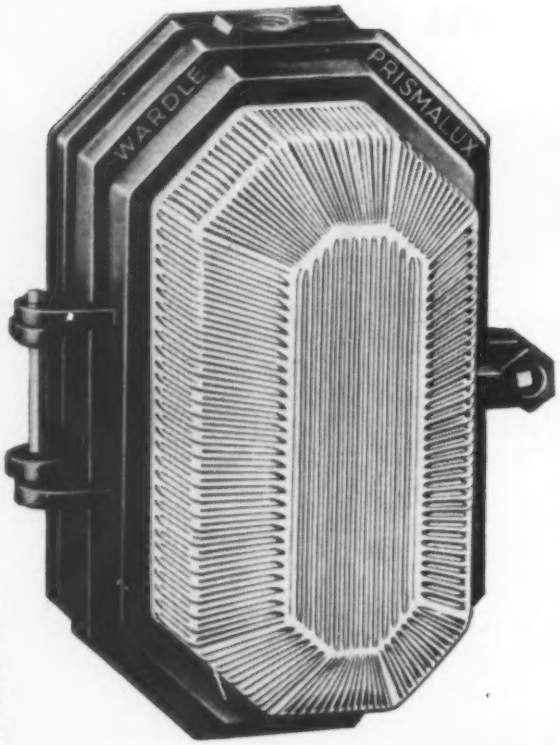

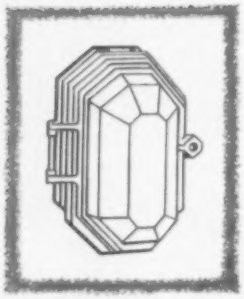

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A magnificent range of fluorescent fittings with many new features in design, finish and ease of installation

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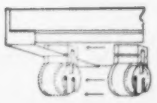
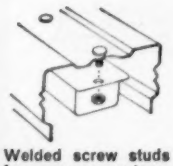
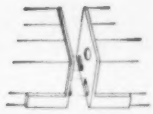


Improved lampholders, need no fixing, no screws.



Welded screw studs for easy gear replacement.



Automatic alignment when mounted in continuous runs. Rugged cast end plates.

atlas atlantic 2

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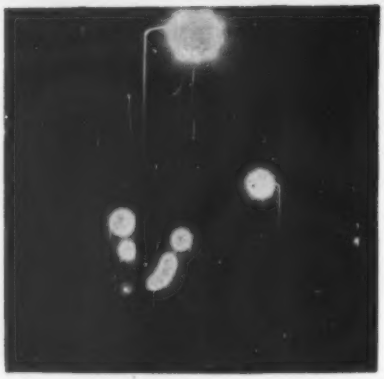
Lighting installation in Pontefract Rd., Featherstone, Yorkshire. Photographs reproduced by kind permission of Geo. F. Adamson, M.I.MUN.E., Surveyor & Water Engineer, Featherstone U.D.C., Yorkshire.



Made to exacting B.S.I. specifications, these elegant Elecoslim columns are the sure sign of street lighting that's *completely* efficient. Each is fitted with an Eleco lantern, which in turn houses a Philips mercury fluorescent lamp. The bright, clear illumination so obtained ensures visibility of an exceptionally high standard, considerably reducing the risk of accident. Both Eleco and Philips have had many years' successful experience in solving street lighting problems of every kind. These two famous names are your guarantee of efficient performance and complete reliability.

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Philips mercury fluorescent lamps give street lighting of an exceptionally high standard. They ensure excellent visibility and reduce the risk of accident. They are available in an extremely wide range of ratings, and their unique isothermal envelope shape is not only aesthetically pleasing, but contributes to their high efficiency and excellent colour correction maintenance. The installation shown here was carried out by Eleco with their world-famous lanterns and Elecoslim columns. The long experience gained by Philips and Eleco in solving street lighting problems is available to you.

Lighting installation in Pontefract Rd., Featherstone, Yorkshire. Photographs reproduced by kind permission of Geo. F. Adamson, M.I.MUN.E., Surveyor & Water Engineer, Featherstone U.D.C., Yorkshire.

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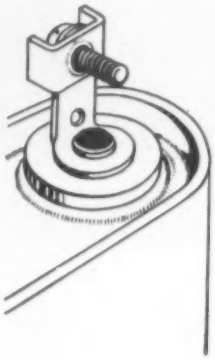
★ *As streamlined as the tube itself.*



SPECIFICATION

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above 250 volts A.C. = Wkg volts x 2.5
D.C. Test = A.C. Wkg volts x 3
To Earth, A.C. wkg volts + 1,000 volts A.C. or 2,000 volts A.C. min
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4 min	250	ZG102	2¼	
5 min	250	ZG103	2⅝	
6 min	250	ZG104	3	
7.4 min	250	ZG105	3½	
3.5±5%	400	ZG106	3¼	
6.8±5%	400	ZG107	5⅛	

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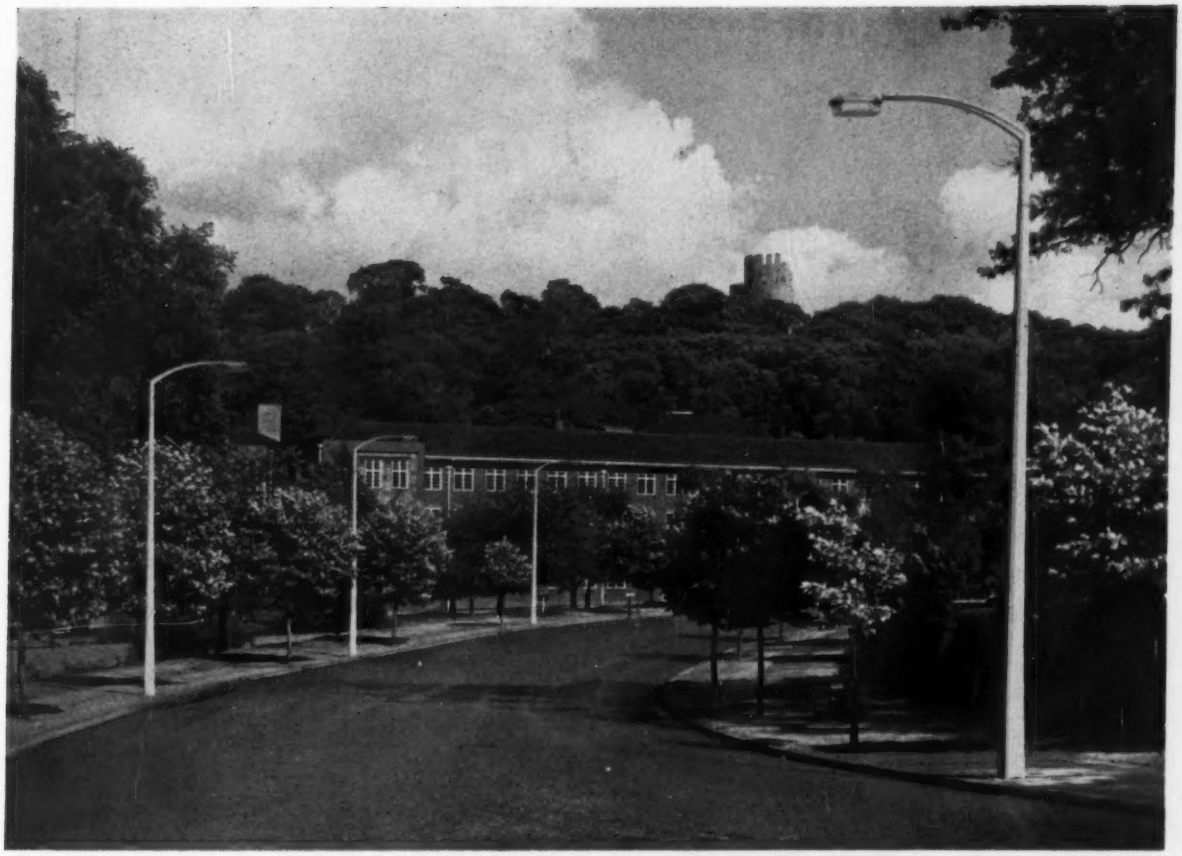
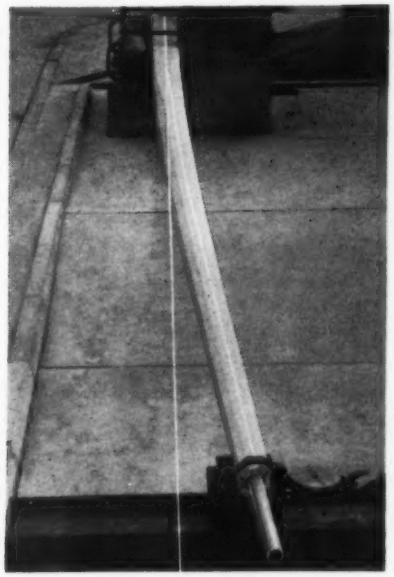


Photograph of one of many Stanton designs acceptable to the Ministry of Transport for use on trunk roads and approved by The Council of Industrial Design.



STANTON

Prestressed Spun Concrete Lighting Columns

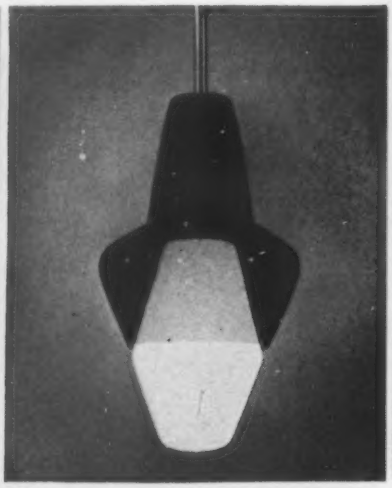
Stanton Type 8F Spun Concrete Lighting Columns at Dudley, fitted with Revo C.15342 lanterns.

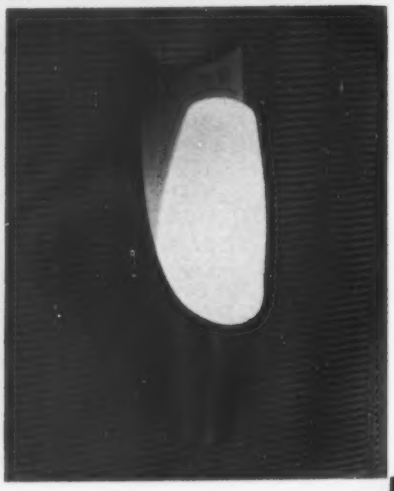
Photograph by courtesy of D. S. Warren, A.M.I.C.E., A.M.I.Mun.E., Engineer and Surveyor, Dudley.

Spun concrete column under a load of 1,092 lb. showing a deflection of 13½ inches. (The British Standard 1308:1957 proof test load is 320 lb.)

The Stanton Ironworks Company Limited Near Nottingham

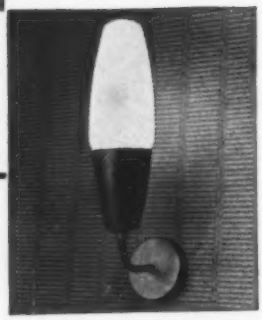
FANTASIA the latest in lighting





Clever design enhances the simple lines of the latest in tungsten filament lamps

Philips new Fantasie range are housed in fittings elegantly suited to a wide variety of uses



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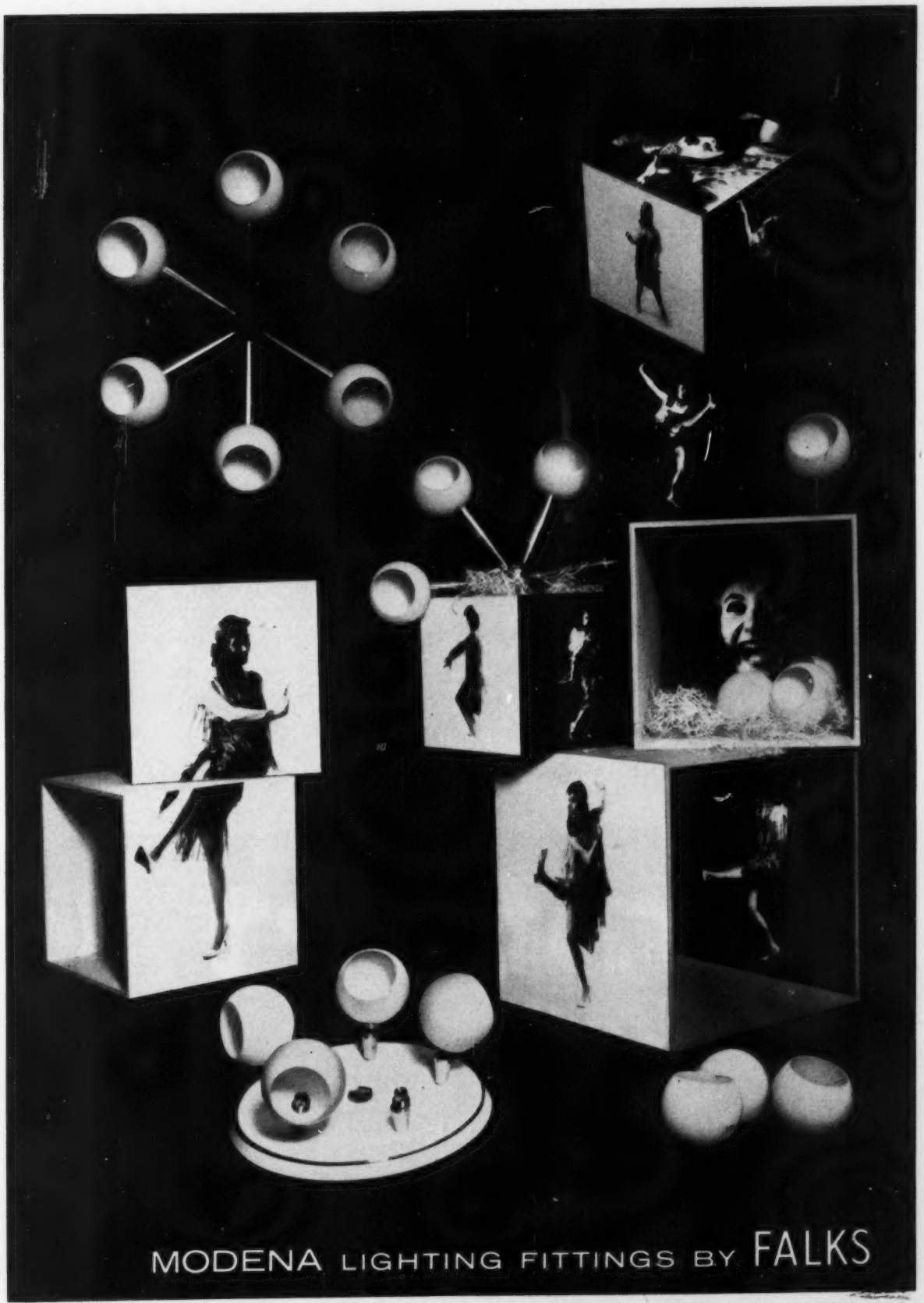

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a code for

The trend in lighting today is towards high illumination. High illumination is an excellent thing in itself, but until now it has inevitably been accompanied by excessive glare with consequent discomfort to the eyes. This discomfort glare, caused not only by the light source itself, but also by the fittings, results in the increased light becoming instead of an aid to efficiency, the very reverse, an actual distraction.

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comfort in

high level illumination without discomfort glare

comfort...

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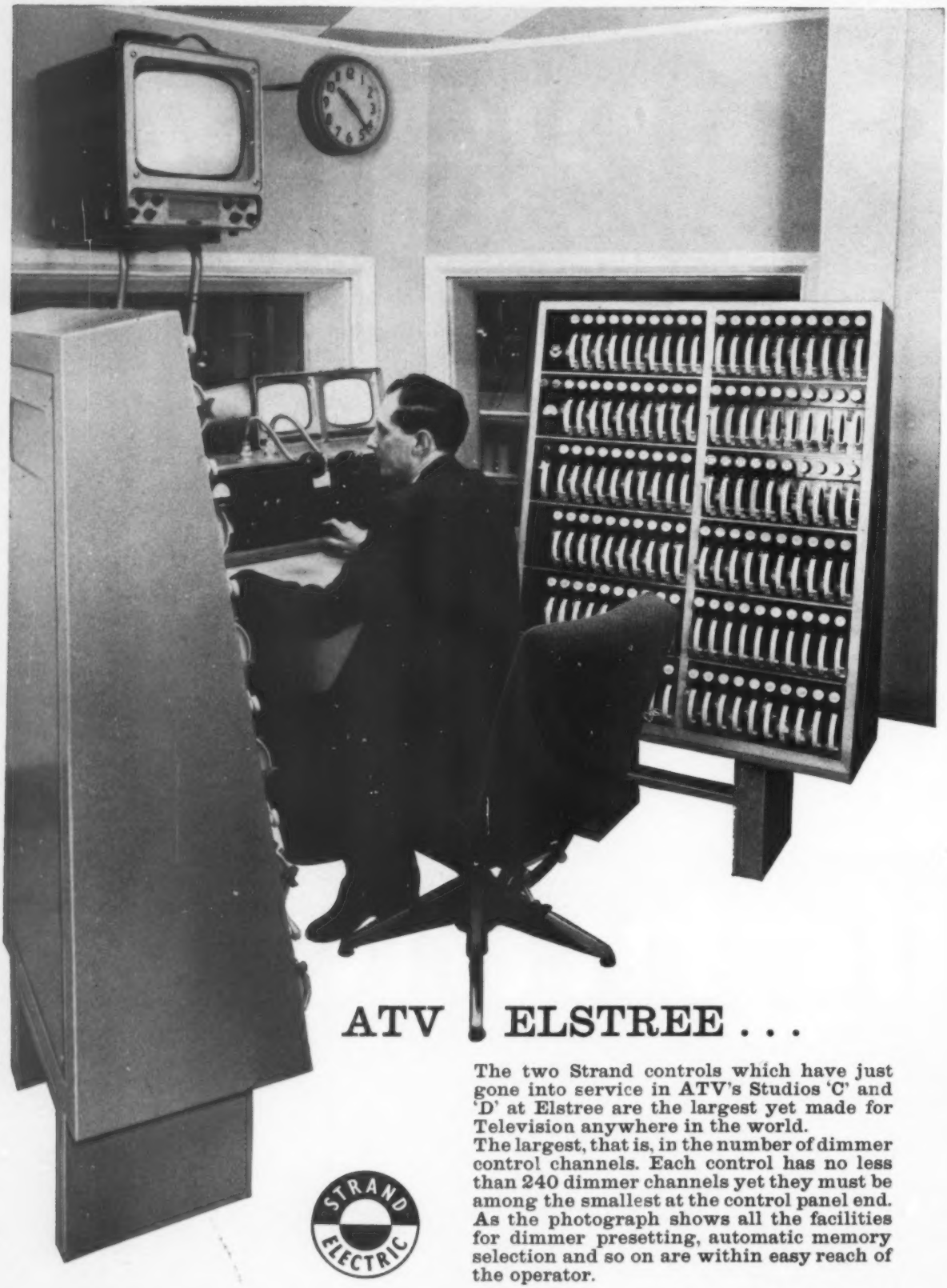

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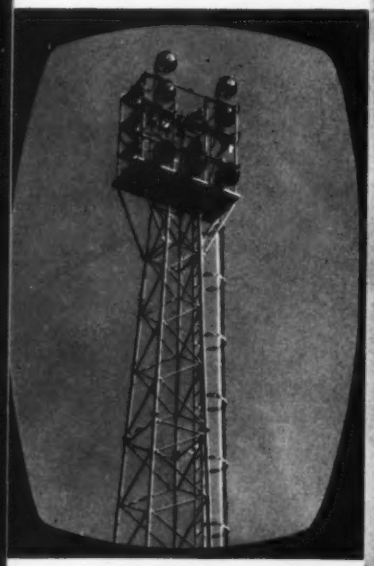

150 ft. standard Floodlighting Tower, type 150/75, for the N.C.B.

Floodlighting Tower, Chelsea Football Ground. This tower, one of six, is 107 ft. 6 in. high and mounts 54 floodlights.

One of ten standard 60 ft. towers with octagonal platforms for floodlighting the S.W. apron at London Airport.

Standard Tripole, height 40 ft. 9 in. One of the six used to illuminate siding at an N.C.B. Colliery. Access ladder built into one face of tripole.

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PS3

Vol. 54 No. 5

Light and Lighting

Editor: G. F. COLE

Assistant Editor: D. B. WILLSON

CONTENTS

Distinguished Fellowship: The speech of welcome made by the IES President in presenting the Duke of Edinburgh with his Certificate of Honorary Fellowship of the Society is reported, together with the Duke's reply **(page 135)**

Introducing the new Code: An abstract of the introductory lecture given by Dr W. E. Harper describing the principles by which the Code's recommendations were drawn up and the objectives at which they were directed **(page 137)**

Appraising the new Code: A critical examination by W. R. Stevens of the Code's recommendations and their likely effect on lighting development **(page 141)**

Reactions to the new Code: A symposium of invited comments, in which lighting engineers, architects and organizations representing certain broad classes of users, whilst generally welcoming the Code, express opinions on the way they feel it will affect their work **(pages 145, 149, 152)**

Lighting Abstracts: A record of recently published work in lighting and allied subjects **(page 153)**

The Society's Annual Dinner: Illustrated report of the major social event in the IES calendar **(page 154)**

National Illumination Committee of Great Britain: Annual report for 1960 **(page 158)**

House-warming at Imperial College: A brief account of the work being carried out, and facilities provided, in the Technical Optics Section of the College's Physics Department **(page 158)**

New Products: Information on recently introduced lighting equipment — Trade literature **(page 159)**

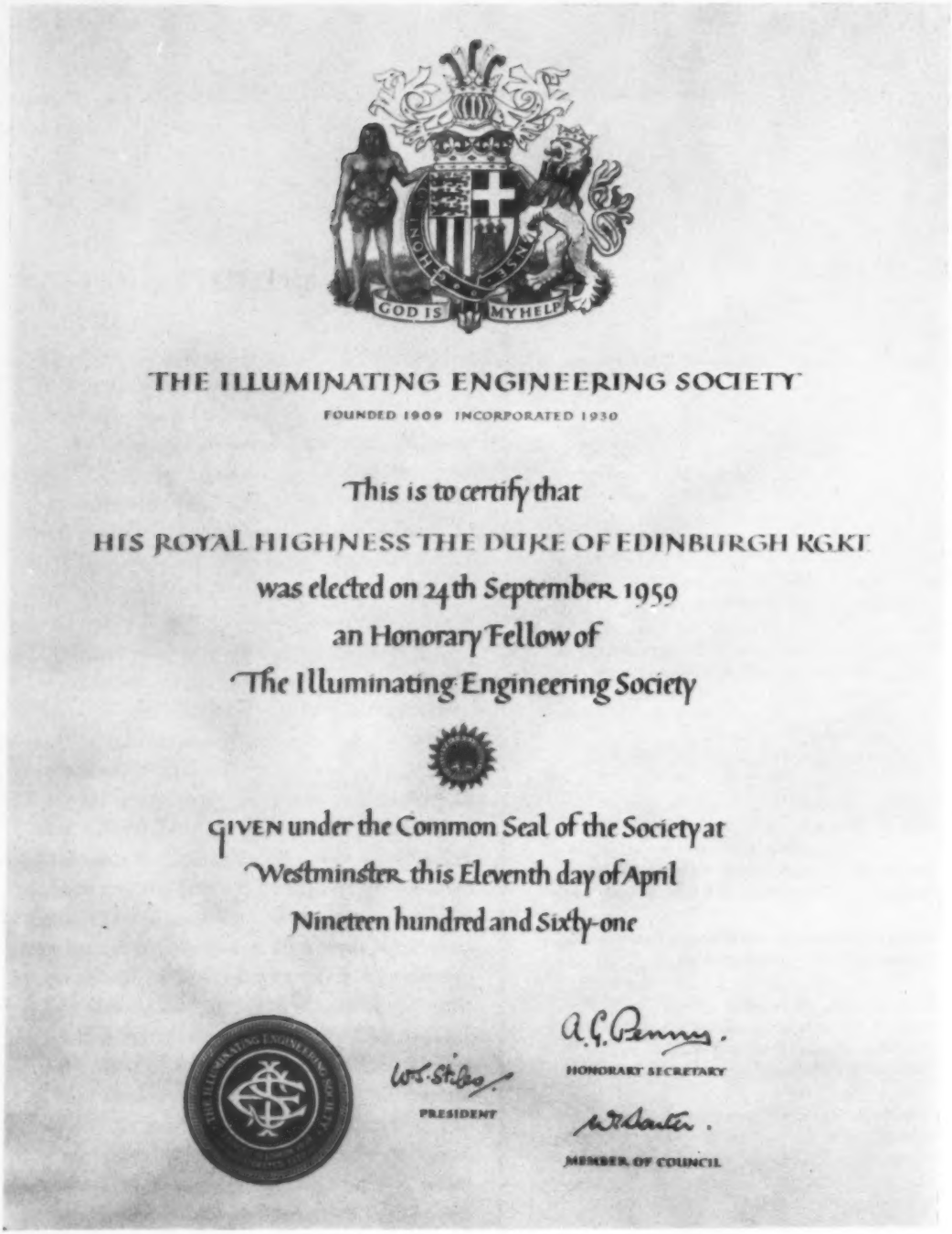
Miscellany: Personal — Overseas news — Industrial notes — Situations vacant **(page 160)**

Postscript: by 'Lumeritas' **(page 162)**

Published by the Illuminating Engineering Society at 32 Victoria Street, London, SW1 (ABBey 7553). Printed in England by the Shenval Press, Simson Shand Ltd, London, Hertford & Harlow.

Code Commentaries

The new IES Code has been out only a short while but reactions to it have been immediate and, as will be seen from comments published later in this issue, they comprise a generous measure of congratulation laced with some criticism. Architects would have liked it to cover more ground than it does; some, and not only architects, would have liked to see it as a comprehensive textbook, something which the Code has never set out to be. Lighting engineers, who have been waiting since American ideas became known, were largely wondering what illumination levels would be recommended. But now that the Code is available, it turns out that of all the recommendations it makes, those on illumination levels are probably the least important, even though they have been variously described as 'revolutionary', 'conservative' and 'refreshingly sane'. Significantly, all concerned have immediately recognised the real advance made by this Code—the recommendations for the control of glare—and these have been hailed in almost every quarter as a major step forward in lighting design. Although it was no secret that an attempt was to be made to deal quantitively with the glare problem, some fittings makers were quick to realise that the recommendations were more drastic than they had anticipated and that rethinking on fittings design may be required to effect compliance with them. It is perhaps, a reflection on the quality of these initial commentaries that already, it seems, there is preoccupation with what might be contained in the next edition but in the meantime lighting engineers have been provided with the best tool they have ever had and quite enough new ideas to absorb for the time being.



GOD IS MY HELP

THE ILLUMINATING ENGINEERING SOCIETY

FOUNDED 1909 INCORPORATED 1930

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HIS ROYAL HIGHNESS THE DUKE OF EDINBURGH KG KT

was elected on 24th September 1959

an Honorary Fellow of

The Illuminating Engineering Society

GIVEN under the Common Seal of the Society at

Westminster this Eleventh day of April

Nineteen hundred and Sixty-one

PRESIDENT

HONORARY SECRETARY

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DISTINGUISHED FELLOWSHIP

HRH THE DUKE OF EDINBURGH RECEIVES CERTIFICATE OF HONORARY IES FELLOWSHIP

OF ALL THE OUTSTANDING EVENTS in the history of the Illuminating Engineering Society, that of Tuesday, April 11, 1961, stands supreme. In essence, it was the London Sessional meeting of the Society at which HRH The Duke of Edinburgh was presented with his certificate of Honorary Fellowship and at which the 1961 edition of the Society's Lighting Code was formally introduced for public use. In fact, it was an occasion at which members present felt themselves to have been privileged in being able to witness what was for the Society its most glorious moment.

The meeting was held in the IEE's newly re-equipped lecture theatre, filling virtually every seat, and, in deference to the request that the presentation should be made at an ordinary meeting of the Society, proceedings opened in the familiar manner; the President took the minutes as read; the Secretary made the customary announcements of future meetings. Dr Stiles then made a short speech of welcome.

He reminded his audience that the occasion was one anticipated with growing pleasure since the Duke had honoured the Society by graciously consenting during its Golden Jubilee year to become its first Honorary Fellow. The Society, he continued, had been founded in 1909 to provide a forum where all persons interested in lighting might discuss the varied problems of a subject then beginning to emerge with an individuality of its own. In the succeeding 50 years, a period of remarkable technical progress and of the growth of a great lighting industry, the Society had fulfilled its role as a unifying body. It is today regarded as the authority in this country on all lighting questions.

He recalled the main lines of research and development that the Society aims to foster, by touching on the general progress which has been made in improving light sources and the means of redistributing the light they emit to ensure its more effective use. Successive papers in the Society's Transactions recorded the mounting efficiency with which power—now principally electric power—is converted into light. 'With the recent production of sodium lamps yielding 100 lm/w, we have reached a kind of four-minute mile in light production—and this is not the end.' Of the redistribution of light, he saw the combination of new materials and light sources as a powerful factor in the integration of lighting with the interior architecture and decorative schemes of much of today's advanced interior design.

But, he went on, the Society had another important function, to ensure that, in parallel with these technological advances, the general standards of lighting throughout the community should be raised. For interiors, the IES Code has provided the main tool for achieving this objective. This Code has been fully supported by Government departments concerned with lighting and is followed, not only in this country, but widely in the Commonwealth and other parts of the world. Naturally, in moving with the times, the Code has

undergone several revisions, and it became evident a few years ago that, in the light of changing ideas on lighting design and the practicability of achieving higher illumination levels, a major reconstruction was needed; the new Code is the result of this reconstruction and, although a good deal more ambitious, will become the authoritative and indispensable guide on lighting requirements for illuminating engineers, architects, builders and for all those authorities who have a responsibility for seeing that their fellow citizens work and play in a happy and comfortable environment.

The President, after expressing the delight which must have been felt by all that the Duke's visit coincided with the publication of the new Code, then took up the Certificate of Honorary Fellowship, turned to the Duke and presented it to him with the words: 'Sir, we are conscious that in the varied scientific and technological activities with which you are associated your interest is always a most penetrating one, and in consenting to become our first Honorary Fellow you not only confer a great distinction on the Society but you put the Society on its mettle to pursue with added vigour the important objects for which it stands.'

In accepting the certificate, the Duke of Edinburgh said: 'Thank you very much indeed for this very delightful certificate. I hope you will be able to keep up the standard with your other Honorary Fellows in due course.' He admitted to a peculiar interest in lighting, arising from the difficulty that the houses he lived in were all designed before electric lighting was invented and one of the problems (which he doubted was covered by the new Code) was that of installing such lighting in houses intended for an entirely different kind of lighting. 'As you can imagine,' he added, 'any given number of people will have the same number of opinions on the subject.'

He saw the present time as particularly fascinating for lighting. In the old days the number of light sources available was restricted: ' . . . we were stuck with candles and had to make the best use of them.' Nowadays, however, there were altogether too many sources and the problem was to find the right answer—something for which we were all groping but so far without having found it. 'I think that by using all available means and by a process of elimination we shall eventually achieve a reasonable standard of lighting for different purposes.' Quite apart from variety in sources, there was, he continued, the technical problem of lighting something with the right colour, direction and intensity and the other problem of making it acceptable to human taste, not an easy task.

From his experience as a motorist, he felt there was still much to do in the way vehicles light up the way ahead and in the way local authorities light, or attempt to light, the road. From his experience as an aircraft pilot, he felt that we have only got halfway to solving the problem of lighting runways at night, and of lighting airfields so that aircraft can move about readily without reference to instruments, except of course in fog.

He finished, as he started, with humour; in a quick reaction to a photographic flash he expressed the thought that one man involved in lighting he would have dearly liked to meet—and to whom he would have been extremely rude—was the man who invented the flash light. Dr Stiles then introduced Dr Harper to present his lecture.

In the picture at the top of the page, the Duke of Edinburgh is seen inspecting his Certificate of Honorary Fellowship; on his right Dr Stiles (IES President), with Mr G. F. Cole and Mr James Orr, on his left Mr A. G. Penny and Dr W. E. Harper. On the right, the Duke of Edinburgh with the President leaving after the lecture.

The scene during Dr Harper's presentation of his lecture on the new Code, with the Duke of Edinburgh and the IES President in the front row

INTRODUCING THE NEW CODE

DR HARPER EXPLAINS THE IDEAS WHICH DETERMINED THE CHARACTER OF THIS REVOLUTIONARY DOCUMENT

DR HARPER'S LECTURE was a brilliant masterpiece of presentation. Whilst its qualities exemplified his qualities as a technologist, its precise and smooth combination of words and illustrations revealed his qualities as an artist. As Dr Stiles commented in proposing the vote of thanks at its conclusion, it was singularly fitting to have achieved such a high standard on this of all occasions, a sentiment which, to judge by the warmth of the applause, expressed the general feeling most aptly.

Dr Harper began by explaining that, as most members present had already had opportunity to study the new Code, he was not going to deal with that document itself but rather with the ideas which shaped the thinking of the members of the Drafting Committee responsible for its preparation. This he did most succinctly and clearly, with the aid of meticulously prepared illustrations and models and yet whose essential simplicity enhanced their impact on the audience. Few of those present can have come away without a much improved understanding of the Code's purpose.

The committee's first step was to agree the approach, and it was accepted from the outset that the Committee's concern was with the design of the whole visual field, that is, with the total pattern of light, shade and colour created within a room or building. It was recognised that the appearance of an interior not only exerts a profound effect on the outlook and response of the occupants but also on the ease with which important detail is seen and the degree of visual fatigue experienced.

The task of prescribing the visual fields suited to different situations was approached by isolating its most important features and treating each separately although it was realised that in practice these components are never separated in this way but are parts of the whole field which is perceived in its entirety. The first component to be so treated was the pattern of brightness and as the pattern is usually complex, it was found necessary to break the pattern down into four major areas: the work itself; the background against which the work is seen; the general surroundings; the light sources.

In most cases, the work being done is the focus of interest and this gave a natural starting point for designing the brightness pattern of the complete interior. The first step was to make sure that the work is made bright enough for all the essential detail to be seen easily and quickly. There were two considerations here; first, the nature of the task and second, the visual efficiency (speed and accuracy) with which the detail is seen. It was not necessarily a simple question of aiming for maximum possible visual efficiency at all times, since highly exacting tasks would then require very high levels of brightness which might not always be justified by the resultant benefits. In many cases, users' needs will be met by a more realistic standard of visual performance.

The Committee, then, were faced with a choice of two criteria for visual efficiency: either 'maximum possible' (which the Americans have adopted following Blackwell's work) or 'near maximum', which was the criterion developed by Weston in this country and which formed the basis of the 1955 IES Code. It was decided that, in the context of conditions prevailing in this country, to continue to base the illumination recommendations on Weston's criterion, this having a notable advantage of permitting adjustments to be made in standards from time to time.

The recommendations, however, were not made solely on grounds of visual efficiency. It was felt that modern ideas on amenity call for a certain minimum illumination; most people today expect a well-lighted building even though their work may call only for casual vision.

Having established the basis for determining task brightness, it was then necessary to relate the task brightness to the brightnesses of the task background and general surroundings. Of the task background, it was desired to arrange the brightness pattern so that attention would be drawn naturally to the work without creating a risk of visual discomfort or strain, by undue contrast between the task and its background. The Committee therefore recommended that, broadly, the background

brightness should be approximately one-third of the task brightness. In an office, for example, this would mean replacing dark polished wood desks for something considerably lighter.

In making recommendations for the brightness of the general surroundings, however, the Committee was faced with a much greater difficulty in view of the lack of relevant data, and was thus able only to give quantitive guidance for the average brightness. In suggesting an average brightness of about one-tenth of that of the task, the Committee did not want this to be interpreted too literally; average brightness was not to be confused with uniform brightness which was the last thing the Committee wanted to suggest. It was also important here to remember that the desired result would be obtained only when the lighting was designed in conjunction with the choice of finishes for the various room surfaces, which required close collaboration between architect and lighting engineer.

One important consequence of the illumination recommendations was their impact on fenestration. In those cases where the room and window dimensions prevent the recommended illumination from being achieved without excessive sky glare, the Committee felt that the building designer should feel free to reconsider the design of his windows to give full weight to such other factors as heat loss and appearance and then achieve the functional lighting requirements by supplementing the natural lighting with properly designed artificial lighting intended to operate permanently during the daytime. This means more than putting in sufficient artificial lighting to 'top up' the daylighting; it means designing the artificial lighting to give a good balance of brightness which also leaves the occupant with the impression that the interior is being lighted by daylight. How this could be done was ingeniously demonstrated by a double projection technique.

Having shown how the Committee established limits controlling the brightness pattern in an interior, Dr Harper reminded his audience that the brightness pattern, although fundamental to a lighting scheme, was but one component of the visual field and he went on to show how they dealt with some of the other components. The first of these was the effect known as modelling, in which directional lighting is used to give shape and solidity to objects. The Committee wanted to show that, used in a general way, directional lighting can reveal the architectural form of buildings (exemplified by Waldram's lighting of Gloucester Cathedral) and can improve the appearance of people and objects within them. In a more specific way, it can be invaluable in revealing additional detail in the task. The Committee felt that this work was now so well established that some guidance on it could be included.

Another component felt to be of sufficient importance to warrant inclusion was colour rendering. The Committee distinguished two categories; in a general way, it felt there were so many occupations where pleasant colour rendering is important to welfare and amenity that it should be given as much consideration as luminous efficiency in the choice of light source. It also, of course, emphasised the need for accurate colour rendering for those situations which involve colour matching or appreciation.

Dr Harper left to the last that section of the Code which may prove one of the most important as well as one of the most controversial—recommendations made for controlling glare from light sources. The importance of the new proposals was indicated by Dr Harper's emphasis that, even if all the other factors have been correctly designed, an installation may still be ineffective by having excessive glare; their controversial nature, he suggested, resulted from their novelty. But the Committee felt that the work carried out by Hopkinson and his colleagues at the Building Research Station justified a new approach to the problem, based on the BRS glare formula but modified to obtain more convenient numerical values by converting the glare constant into a glare index.

From this starting point, the Committee was faced with two problems. It had first to decide the degree of glare which could be accepted without discomfort in different situations and express that degree numerically as limiting values of glare index. Then it had to devise a method by which the practising engineer could calculate quickly and easily the glare index for the particular installation he was designing and compare it with the recommended limit.

It was agreed that the amount of tolerable glare depended on the nature of the task and that what was needed was a series of limiting values of glare index which would express this difference. To determine the series, a team of observers made subjective assessments of glare at about 100 installations, combined their observations with laboratory and field data already available at the BRS and then translated the results into the limiting values given in the Code. These values refer to the glare experienced by the occupants of a building when they look up from their work; it was held to be unlikely that occupants will be troubled by glare when their attention is really concentrated on the work. In the same way as the illumination recommendations, the values are meant to be economically realistic.

Having determined the permissible degree of glare for particular situations, the Committee then tackled the problem of glare calculation for a proposed installation, and with the aid of electronic computers, were able to prepare tables from which the glare index for a general lighting installation under a wide range of conditions could be derived in a matter of minutes. The tables are limited to artificial lighting

near right, H. C. Weston
far right, A. W. Beuttell

25 Years of IES Codes

Although lighting codes had been issued by other bodies, it was not until 1932 that the Council of the Society decided to prepare an IES Code. The Technical Committee was asked to prepare the necessary work and its chairman, A. W. Beuttell, put forward for discussion a general method for computing the illumination desirable for any visual task, provided the relationship could be ascertained between each of the principal visual characteristics of a task and the illumination required to 'compensate' for the difficulty imposed by these characteristics. This entailed experimental investigations which, on the representations of the Society, were sponsored by the Medical Research Council and the DSIR and carried out by H. C. Weston at the NPL. This led to the publication in 1936 of the first schedule of 'Recommended Values of Illumination'. Further basic studies prompted by Beutell's original proposal were carried out, the results of which became available in 1943. In the meantime, revised editions of the 1936 'Values' had been published, augmented by brief notes on good practice; the title 'IES Code' was first used in 1941. Also in 1943, Weston presented his 'Proposals for a new Lighting Code' stemming from the results of his further investigations and a new code, based now on experiment as well as experience, was issued in 1945. This code was revised with improvements in 1949 and again in 1955. The 1961 Code, however, is not a further revision but a completely new document incorporating new proposals, on illumination advanced by Weston in 1960, and on controlling glare resulting from the work of R. G. Hopkinson and his colleagues at the Building Research Station adapted by the Luminance Study Group of the IES Technical Committee. Moreover, in guidance and recommendations, the 1961 Code is more comprehensive. In many ways, this new appearance results from the leading part played by W. E. Harper who was responsible for co-ordinating the work of the panels set up by the drafting committee as well as making his own contribution to its content.

installations in which the fittings are arranged regularly overhead but even then they cover many situations encountered in normal practice. They had been subjected to a sufficiently large number of practical checks to be put forward with confidence and, in Dr Harper's concluding remarks, with an undeniable sense of achievement.

Discussion

For the discussion, Dr Harper was joined by Dr R. G. Hopkinson, Mr W. Robinson, Mr W. T. Souter and Mr H. C. Weston. In opening, Dr J. N. Aldington, after calling to mind some of the events in the history of IES Codes, wondered whether the present Code was not too modest. He cited the comment in the preface concerning the interpretation of the Code's recommendations and compared this to the preface of The Highway Code, which placed much greater emphasis on adherence to recommendations. He submitted that, were it not for the eye's power of adaptation, this Code would have to be recast as a mandatory condition in the use of all buildings and related spaces. He thought it would be useful for those outside the Society who came to read the Code to understand that because the eye can still operate in one-millionth of sunlight illumination, the Code, whilst giving values of illumination higher than in previous issues, has still to take account of economic factors which may determine or limit the illumination provided. He concluded by asking to what extent account had been taken in the revised values of illumination of the fact that the average age of persons employed in industry had increased so much since 1939.

Mr W. Allen, presenting an architect's viewpoint, said that the most obvious achievement was the development of glare control. Whilst recognising that the glare index system was not applicable to every installation, he felt the Code, by sensitising the whole profession to glare generally, would create a sensitivity to glare in a great many situations which it could not cover. The other quality possessed by the Code which endears it to the architect is its sense of balance and perspective. In comparison to earlier Codes, it gave the feeling that the Society had come a long way in what architects would say was a desirable direction. The control of texture, modelling and form in the surroundings was something which architects knew to be very important but of whose importance they were sometimes unable to persuade engineers; the code now provided specific recommendations on these subjects.

Mr Weston, in replying to the discussion at this point, took up Dr Aldington's remark on age. He explained that the experimental data employed in the Code related to people of an average age of 37, which did not appear to differ much from his view that 40 was now the average occupational age. The Code made some attempt to provide for the age factor by introducing a multiplying factor of 1·5 for situations involving personnel of an average age exceeding 40. Mr W. T. Souter continued the reply by pointing out that, during the war, the Society's Code was used as a standard for levels of illumination required by Ministries and other authorities, but it was not for the IES to make it mandatory.

Mr J. S. McCulloch continued the discussion, speaking as a consulting engineer, in which capacity he had to decide whether the Code was a good tool which would serve him well or whether it was a bad tool which would be misleading; from the point of view of a practitioner, he looked on it as a good tool. If the circulation of its predecessors was any criterion, this Code will be used to design many thousands of lighting installations by some thousands of engineers who have no knowledge of and little interest in the fundamentals used in its preparation. The meat of the Code was contained in Part II and the glare treatment was its greatest advance, particularly the inclusion of tables. To assist the consulting engineer even more, he asked that manufacturers made available design data on their fittings as quickly as possible; he hoped they would not be as diffident about publishing BZ Classifications as they had been on co-efficients of utilisation. He wondered, in conclusion, whether steps were now being taken to obtain more accurate information on the preferred values of illumination for many of the tasks for which at present there were little authoritative data, in order to be in good time for the next edition of the Code; Dr Harper replied that some of the present committee were to meet in the near future to decide who will undertake the next Code. He also added that it seemed the Society had the next Code's editor, in reply to some detailed comments made by Mr Fothergill on the typographical presentation.

Mr J. G. Christopher welcomed the Code. He said the emphasis lay on quality rather than quantity in lighting and was awaiting with interest the reaction from the USA. He felt that the provision of an amenity level of 15 lm/ft² was good. The cumulative effect of higher levels was considerable; no doubt the amenity level would go up again in about ten years' time.

Mr G. V. McNeill suggested that, in choosing a satisfactory fitting to give the desired glare index, it would help if manufacturers were to give the maximum and minimum glare index for each fitting in their range, and he described how these values could be calculated. It was important, he added, to realise that the reference to the downward flux output from fittings should be based on the average lumen output of the lamps and he felt that the tables should make this clear. He concluded by pointing out that interpolation between values in the correction tables was simplified by first plotting the tabulated values on logarithmic graph paper, which gave a straight-line graph. Mr Robinson replied that he would hesitate to publish glare indices for fittings; it had been the intention of the committee to relate glare indices solely to installations.

Mr Derek Phillips commented that because the differences between the present and past Codes were associated largely with the 'lighting function', they could not be regarded as altering the criticism levelled at the previous Code that it was insufficiently orientated towards the architect. There was an almost complete lack of information architects need on the architectural function in lighting. By architectural function, he meant the architect's original concept of the appearance of his space and the lit appearance of the lighting equipment; in other words, the effect that the various available methods of lighting have on an appreciation of space. He suggested there was some inconsistency between the recommended levels of artificial lighting and for natural lighting in certain buildings, in which consequently, p.s.a.l. would always be required. As p.s.a.l. usually involved more fittings than those for the artificial lighting installation, this might also result in greater glare, and he wondered how this had been accounted for in the glare index tables. In reply, Dr Hopkinson pointed out that the levels of artificial lighting were concerned primarily with the 'working' illumination. If the daylight factor was insufficient to give adequate working illumination, then it became a function of the character of the building and was determined on its own merit. In other words, the committee felt that working illumination and daylight factor were two separate entities and it was the job of the architect and lighting engineer to marry the two. On the effect of p.s.a.l. on glare, he said that the greater illumination would result in a greater background brightness, which would produce appropriate alleviation of the increased glare resulting from the larger number of light sources.

The final speaker, Mr John Reid, argued that architects tend to think visually and not in mathematical or engineering concepts, and for this reason he regretted the lack of illustrations in a book primarily concerned with visual matters. He recognised that it was not possible to codify qualitative effects and their working out must be left ultimately to the architect but felt there was need for expansion of these aspects.

Dr Harper wound up the discussion by expressing his thanks to all those who had worked with him (notably Mr Longmore, Mr Hewitt, Mr McNeill, Mr Rowlands, Mr Clark and Mr Wolsingham) and whose efforts had been as important as his in the success of the presentation.

To what precise extent the new IES Code will affect the future development of installation and fittings design is impossible at present to say. It is possible, however, to examine examples of what has currently been regarded as good lighting practice and to deduce how these examples would comply with the new recommendations This has been done for the illustrations shown below and on pages 144, 148 and 150. It must be pointed out that the comments, which are concerned largely with glare conditions and assume that in most cases the illumination levels will be acceptable, were based on examination of the pictures and not on the installations themselves and that, in any case, no more than a general comment is possible A detailed individual analysis of each installation would be required to state definitely that it did, or did not, comply with specific recommendations

Far left, intricate assembly being carried out in an illumination of 270 lm/ft², which could be achieved only by mounting the fluorescent fittings just above the benches; their closeness to the workpeople makes the use of opaque reflectors essential to avoid any risk of glare. Near left, a rubber factory in which the cut-off of the trough fittings for the general lighting probably gives adequate glare control; the arrangement of the inspection tables requires care in the choice of surface in view of the darkness of the objects being inspected. Below, a large engineering shop; the limiting glare index for such areas is sufficiently generous for the installation of high-bay blended-light fittings to give satisfactory conditions.

APPRAISING THE NEW CODE

A CRITICAL EXAMINATION OF THE NEW RECOMMENDATIONS AND THEIR LIKELY IMPACT ON LIGHTING DEVELOPMENT

By W. R. Stevens

THE FIRST IES CODE appeared in 1936; the 5th edition thus celebrates a silver jubilee as well as having royal associations. The new Code needed to be good and happily it is.

The keynote of the document is boldness. It tries to be definite instead of diffuse: it uses numbers instead of words wherever it can. It has put numbers, for example, to discomfort glare to a greatly increased amenity level of illumination, to the necessary value of artificial lighting designed specifically to supplement the available natural lighting. (This, incidentally is the most unhandy lot of phraseology in the whole test: can nobody suggest an alternative? Would 'Daytime Artificial Lighting' serve?)

Putting numbers to things previously expressed as vague generalities is a dangerous exercise and this code certainly 'sticks out its neck'. It will be surprising if some axes are not swung at the inviting target and some of the blows will certainly do damage. But I suspect that this is going to prove an unusually tough neck and that it will survive substantially in one piece.

The Preface refers to three matters which 'received particular attention' in the revision: they are the three already referred to: direct discomfort glare, the basis for determining illumination levels, and design for daylight. Consider each in turn.

Direct discomfort glare

Workers in lighting engineering have realised for years the need to control glare. In some applications such as motor car headlights we still have to accept some disability glare: in most interior applications time and experience have shewn how to avoid disability and even to reduce discomfort to reasonable levels. But the problem increases in severity as illumination levels rise and both for the purposes of design and specification some figure of merit has been sought, some formula by which glare could be computed. The fundamental difficulty is that glare, like so much else in lighting, is a subjective phenomenon. Like beauty it is in the eye of the beholder.

But there is a useful common measure of agreement on beauty—a rich sunset, Gina Lollobrigida, the Taj Mahal; why not on discomfort glare? Twenty or more years ago, Hopkinson shewed that some sense, at least, could be made of the problem as far as street lighting was concerned. Was the interior lighting problem impossible to solve? Many workers nibbled but the first real bite can fairly be attributed to the ingenious Ward Harrison who, with Meaker, used a combination of experiment and common sense, reminescent of his notable work with Anderson on utilisation coefficients, to produce results not only sensible but practical; they were expressed in a form which made them suitable for everyday use. Other workers gained strength from this progress. Among the best solutions proposed was that from the Building Research Station (in which Hopkinson again played a leading part) and it is this set of results on which the Code recommendations are based.

The formula is essentially simple, but its evaluation for a given installation is tedious. Here the Code shews a nice ingenuity. Where the distribution can be expressed as a British Zonal (BZ) Classification, and where (as is generally the case) the fittings are arranged in a regular pattern, the calculation has been reduced to simple terms largely by reference to tables. In fact the only information required for the fitting in addition to the BZ classification are the light outputs in upper and lower hemispheres and the luminous area as seen horizontally or from below, depending on the light distribution. The BZ classification needs some explanation particularly as the Code refers us for a description to IES Technical Report No. 2 which has not yet been published. The classification is a set of ten polar curves of light distribution in the lower hemisphere each of which is a convenient (and simple) trigonometrical function.* Many typical distributions can be fitted to one or the other of these curves. For the exact procedure, Technical Report No. 2 should be consulted.

Glare and illumination

It does not require second sight to guess that Technical Report No. 2 will shew the BZ curves applied to the calculation of coefficients of utilisation. Thus the same basic data—namely the light distribution—will be the major information needed both for calculation of glare and illumination, a procedure both ingenious and elegant, and one which Harrison himself would applaud. For all that, I must admit some regret that his two major contributions are now disposed of in one fell swoop and I should certainly like to see the evidence that the new methods are genuinely better than those which they displace. The report of some first class work comparing illumination values measured in real installations with calculation by both methods would be a great comfort to those of us who find it hard to move with the times, as well as showing respect for the Harrison system which has served us so well for so long. Similarly we need an authoritative account of the field trials on glare which must have formed the basis for the Code. For the method of calculation is only a part of the story. The Code gives a limiting glare index for each of many types of interior just as it gives a recommended illumination. I would like to see the evidence both that the method is sensible and the limits reasonable.

They probably are, since the people who prepared the Code obviously know their subject: but some questions need answers. For example, in all the welter of methods of appraising glare there have been few correlations of theory with practice

* For example, in BZ1, intensity is plotted as proportional to $\cos^4\theta$ (where θ = angle from downward vertical); in BZ6 intensity is proportional to $1+2\cos\theta$, and in BZ10, proportional to $\sin\theta$. A flush-mounted perfect diffuser is BZ5 (intensity proportional to $\cos\theta$); a pendant opal sphere would be BZ8 (intensity constant).

APPRAISING THE NEW CODE continued

where there have been good correlations they have come mostly from those wishing to advocate a particular formula. Rowlands was unable to find such a correlation although he tried several well proclaimed methods including (basically) that used in the new Code. What has changed? Perhaps the discrepancies which he reported are small enough to ignore for practical purposes. Again, the Code's glare system seems not to make allowance for illumination level. It is based (I believe) on a 1 to 1 spacing/height ratio; but it is commonly held (and I think correctly) that 'doubling up' the number of fittings in an installation will increase the glare. How far is it legitimate to ignore this effect? Perhaps our knowledge is not sufficient to make the correction with sufficient accuracy. Perhaps a correction would be difficult to include because it would complicate the calculation too much. The Code Committee must have had some very good reason for ignoring illumination level; it will be most interesting to hear what it was.

Glare indices

Now turn to the limiting glare indices. The Committee must have had a high old time sorting out these values. One can imagine many fretful hours of discussion and many torrid arguments. One can imagine too, many full blooded reactions from both manufacturers and users when they get to grips with the recommendations. It takes some time to realise just what the figures mean. For general offices, no more bare fluorescent lamps (unless the office is no bigger than a filing cabinet); no plastic or enamelled troughs unless louvered; few of the so called decorative fluorescent fittings. For a drawing office, only a few rather special designs will pass the test. In factories, that old war-horse, the dispersive reflector, is out for many purposes and for the finer work, again, only a few special designs will serve. For hospital wards absolutely nothing—but nothing which will do; for nothing, read, only one or two fittings at present regarded as rather special and commanding a rather special price. It will not be popular.

And yet if you examine any of these examples you are bound to feel sympathy and admiration for the Committee—or at least, I am. Consider the industrial dispersive reflector, for example. It has given admirable service in factories for more than thirty years. Should we not do better now than we were content with in 1930? Surely by present day standards it only just scrapes by at best and when used to provide illumination values of 50 lm/ft² and upwards it is generally over the glare limit. Evidently the Committee has decided that the Code means what it says—'recommendations for *good* interior lighting'; not 'sufficient and suitable', not just passable, but good. Even so industry still seems rather hard done by as compared with the office: is there a real justification for subjecting an office machinery assembler (fine work) to more glare than a business machine operator? Is the social status of a white collar still lowered when smeared by an oily thumb and the sensitiveness of its wearer reduced? Or is the Code recognising that bad factory practice cannot be pulled up to the best in one quick haul?

If so, I sympathise and agree with the Committee once again. For the great danger of this section on glare is that it will prove too strong a medicine for most customers and that after one dose—or even a smell—they will throw away the bottle. That would be tragic, for it would cast the whole Code into disrepute; the Code must not only be valid but must be recognised as such. The onus now falls on the Society's sustaining members. As manufacturers they must not only discover and design equipment which will comply, but also accept that some of their cherished and profitable pieces will gradually slide into the vagueness of memory. As users we will all have to spend more money. Unless both parties recognise that the trouble and expense will be worth while in the long term, the Code—or at least, this part of it—will die the death, and it will be years before another such golden opportunity is presented.

Illumination levels

The new recommendations for illumination level show the expected increase of 50 to 100 per cent over the 1955 edition. It is interesting to note some of the changes since the first issue of Recommended Values of Illumination in 1936.

The effect of wartime experience can be seen in the upgrading in 1946 for fine and extra fine assembly work, and for the office worker. Shops and stores were less important. Even now the value 15 to 30 lm/ft² (with supplementary lighting 'as required for counters and display areas') is lagging well behind many practical examples since chain stores and supermarkets considerably above the 100 lm/ft² mark are to be seen. Their case, of course, does not rest simply on 'adequacy for the performance of visual tasks at satisfactorily high levels of efficiency' or even on 'adequacy for pleasantness and amenity' (the Code criteria) unless sales appeal is a sort of super-amenity. But the Code can hardly take into account the commercial value of lighting for display; its basis is 'visual performance' and reasonable amenity.

The illumination values chosen still rest upon the proposals made by Beutell as worked out by Weston. As the Preface points out, there have been new and

RECOMMENDED ILLUMINATION LEVELS OVER 25 YEARS

	1936 *Foot candles*	1946 *lm/ft²*	1955 *lm/ft²*	1961 *lm/ft²*
General offices	5–10	20	20	30
Drawing offices	25–50	30	30	45
Assembly shop—rough work	5–10	7	7	15
,, ,, medium ,,	8–15	10	30	30
,, ,, fine ,,	15–25	50	50	70
,, ,, extra fine work	25–30	100	100	150
Cloth Inspection—light	8–15	—	30	45
,, ,, medium	—	20	—	100
,, ,, dark	15–25	—	70	150
Hospital wards	2–4	3	3	10–15
Hotel dining rooms and lounges	5–10	7	7	10–15
School classrooms	5–10	15	15	30
Shops	8–15	15	15	15–30
Departmental stores	15–25	15	15	15–30

interesting techniques from other places, notably Russia and America. They have been carefully studied by the Code Committee, but not adopted. I am glad to learn this. Although the Russian Code is interesting, their system of doubling the required illumination when obtained with fluorescent lamps smacks more of expediency than truth: and although expediency has always had a major influence on illumination levels (perhaps a decreasing influence as our knowledge grows?), it is nice to feel that some attempt has been made to provide a scientific basis.

The American values are, of course, based on the work of Blackwell. One wishes not to be unfair to an imaginative and carefully conducted programme of experiment, or to the men who converted the results into everyday terms. But I admit that some of their procedure I fail to understand, and some of what I understand I do not believe. I think some others are with me but I hope we are not merely tight-laced by national prejudice. One of the worrying features of the American procedure was their ability to find a need for quite high values of illumination for quite simple visual tasks. It is not necessary (as far as our present evidence goes) to have high illumination in order to see simple tasks and if we pretend it is we only encourage the suspicion that the lighting salesman is setting the pace rather than the scientist. The British method, which accepts that there is an amenity level of illumination irrespective of the work being done, is, I think, both more honest and more satisfying. The bold step in the new Code is to push this level for all working areas up from 6 lm/ft², where it has been for many years, to 15 lm/ft². Obviously in industry there will be places in which such a level is stupidly uneconomic but for the most part, the Code implies that 15 lm/ft² is akin to proper sanitation, and comfortable temperature, a lunch-time break; in other words an amenity which every worker should normally enjoy.

'Artistic' lighting

Of course, as the application moves from industry through commerce to entertainment or the home it becomes increasingly difficult to decide what constitutes amenity or indeed what is an appropriate level of illumination or glare. At this 'artistic' end of the scale the Code is almost inevitably of little use and, indeed, would be a positive handicap in such 'social' areas as hotels and restaurants. What we need is some simple advice on brightness patterns—some boiling down of the techniques which Waldram has described for interior design, to give a clue to the designer who wishes to relate illumination to brightness pattern without going through the whole formal procedure. Dykes-Brown and I made an attempt in our paper on hotel lighting but evidently with little success. Please, will someone else try?

'Working' illuminations in the Code are based on a visual performance range between 90 and 100 per cent—a convenient way of avoiding too close an examination of the actual levels chosen (cowardice or commonsense?). A list of special circumstances for which the values should be increased by 50 per cent includes people over forty years but does not include children or learners. Surely the inexperienced usually need all the help they can get!

Our old friend the illumination scale has vanished in this edition to be replaced by a nomogram, and a more detailed account of the derivation of illumination from critical size and reflection factor. My guess is that this, although interesting, is a mistake. The old illumination chart was not only picturesque but crude enough to encourage one to make an estimate. The new form is a little frightening and in any event it takes an expert to say what really is the critical detail in any task. However, this is a minor quibble as would be the suggestion that the step between 30 and 70 might be better put at 50 than at 45 lm/ft²; that odd 5 conveys an impression of accuracy which is not warranted. But all in all, this section of the Code is admirable.

Daytime artificial lighting

The third bold step in the Code is its support for an admixture of artificial and daylight: 'When all the requirements have been satisfied it is likely that for many buildings a properly integrated system of natural lighting and permanent supplementary artificial lighting will give the best lighting during daytime. It provides a means of achieving adequate illumination over the whole working area, freedom from dark and gloomy corners and freedom from sky glare while still retaining the dominant daylight character of the room and satisfying the architect's requirements of daytime appearance.' Wise words, and congratulations again to Hopkinson and his colleagues for their fundamental experiments.

Whether, in fact, the system proposed is necessary, is another matter. It still leaves a considerable onus on the architect to make assumptions about mean sky brightness, for example. Could he not be recommended to take the standard figure of 500 ft-L in this country? But my chief wonder is whether it would not be sufficient to include a normal high quality artificial lighting installation. Would this depart greatly from the values determined by the Code formula? If not it would be a great simplification in design and installation, it might encourage the use of high standards of artificial lighting, and would not have the frightening need for higher artificial illumination by day than by night. The idea that windows are not only concerned with admitting light and that illumination needs should not dominate the fenestration of a building is of such fundamental importance that one would not want to hamper it by sticking too rigidly to theoretical niceties. Let us hope that by putting its cachet on the principle, the Society has helped to encourage its practice.

Some other matters

There is a good deal more in the Code, mostly descriptive rather than quantitative: sections, for example, on brightness patterns, form and texture, stroboscopic effect and flicker, emergency lighting; and an important discussion on maintenance. How far such general accounts can make an impact on a reader is a moot point, particularly when the material is compressed. For the expert there is little new, but at least the Code does not talk down to him. For the tyro there may be much more implied than he realises. The situation is easier when a requirement can be expressed in numbers but relatively few important things can be so expressed. There is a great danger that the layman, armed with an authoritative and elegant document, will feel that he can dispense with professional services: the Code might well have made its intentions more clear in this respect.

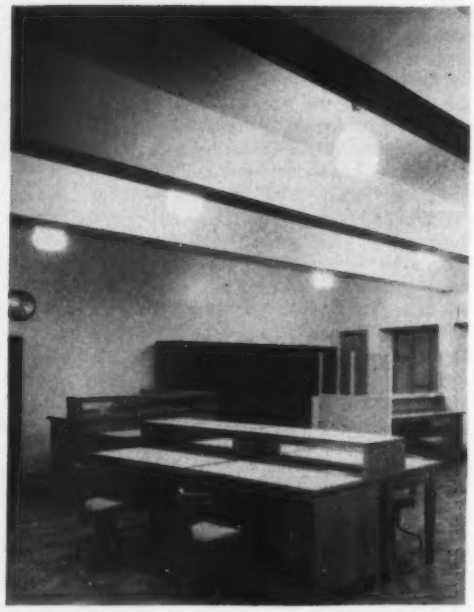
For it is authoritative and it is elegant, what it says is worth saying and is said remarkably well. The presentation is in a completely different class from previous editions. Size, paper, type face and layout make the document look proud of itself and we should congratulate and thank all those who had a hand in the job. These 'simple' matters like choice of word, and arrangement of headings are easy to criticise after the event: less easy to create from thin air, particularly when a committee is involved.

Lines of action

Now three main lines of action are needed. As I have suggested earlier, those who understand the Code and believe in it should encourage others to make use of it 'passim spargere codicem'. Those who devised it should describe some of the supporting work: and the Society should consider where to go from here.

The Code grows bigger with each edition: is it to become a text book? Or should it become a handbook giving facts and figures without trimmings? If it publishes details of glare estimation should it not also include illumination calculation? What about scales of apparent brightness (perhaps the next major move in lighting design)? Should not the IES publish recommendations for exterior lighting? If so how do we relate our Code to the Technical Reports? Do we still continue to call it a Code?

There is much to be done by the willing band with strength enough and time. In the meanwhile hasten to spend your 12*s*. 6*d*. It is excellent value for money.



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(1) For most school rooms, it seems clear that the use of diffusing fittings arranged across the line of sight will produce a totally unacceptable glare index. (2) A gymnasium presents a particularly difficult glare problem in view of the frequency with which occupants need to look upwards directly into the light sources, thus requiring great care in the control of light distribution. (3) This special-purpose classroom is included as a reminder that the use of bare lamps (already rapidly falling into disfavour) is now roundly condemned by the new recommendations and it is hoped this practice will soon become a thing of the past for all but the most out-of-the-way locations. (4,5) A contrast in office lighting. It seems likely that the new Code will show diffusing filament-lamp fittings to exceed the glare index limit for most offices; luminous ceilings, on the other hand, have no glare indices and are not yet considered as a source of quantitively significant discomfort glare.

REACTIONS TO THE NEW CODE

INVITED OPINIONS FROM THE LIGHTING INDUSTRY, ARCHITECTS AND ORGANISATIONS REPRESENTING USER INTERESTS

Lighting engineers' comments

C. DYKES BROWN
The General Electric Co. Ltd.

When the consultant, or lighting designer receives his copy of the new IES Code, his first reaction on looking through its pages may well be one of apprehension. Whereas in the past he probably confined his calculations to illumination values, he now observes that he is confronted with such terms as 'BZ Classification' and 'Glare Index', both of which may be new to him. He will be well rewarded, however, and his fears soon dispelled, if he takes the trouble to study the Code and obtain an understanding of all it implies. He should certainly resist any temptation to disregard the recommendations made, even though a little more time and a greater effort will be needed in its application.

It would appear desirable to use a standard form of procedure when making lighting calculations, which will reduce to a minimum the liability for errors. This would seem to be especially necessary until sufficient practice has been gained and the lighting designer has made himself fully familiar with the new Code. As an interim measure, he would probably find it expedient to enter his calculations on to a standard reference sheet, which summarises the stages step by step, and would thereby ensure that no omissions had been made. For example, it would be easy to forget the 'Conversion Terms' in Table 4, but they would not be overlooked if there were a place for them on the calculation or 'work' sheet. One lighting organisation has already drafted a 'work' sheet showing each stage of the calculations and this is proving extremely useful.

Designers and manufacturers of lighting fittings are now faced with a careful review of their equipment and will probably find that both thought and ingenuity will be necessary to produce ranges of fittings which comply with the requirements of the Code for various types of installation. Small modifications may be required with some equipment, but new designs will have to be considered for many situations.

For many years there has been a steady move towards higher levels of illumination, and this has frequently brought with it glare problems which have not always been taken seriously, although some manufacturers have been emphasising the need for lower brightness lighting fittings. Acceptance of the Code will increase the demand for these, and it may well be that specially designed louvers, on the lines of some already available, will gain favour for incorporation in fluorescent fittings. It will be noted that the popular single batten fitting, previously used so extensively, is no longer suitable for general office lighting if the installation is planned in accordance with the Code.

The lighting designer should soon apply the recommendations made in the new Code, but he will be unable to make much headway until he is provided with the appropriate BZ classification for the lighting fittings at his disposal—an urgent task awaiting manufacturers.

All concerned with lighting will have the task of educating the user in the desirability of adopting the Code and the necessity for adopting it correctly. They also have the task of making the architect aware of the glare characteristics of glazing, wall, ceiling and floor finishes, and in addition make manufacturers of equipment used in buildings, such as furniture and office appliances alive to the need of eliminating highly reflective surfaces.

Many concerned with illumination will profit directly as a result of increased levels of lighting, but if we interpret the Code correctly, particularly with regard to glare control, we can justly claim to take a professional attitude in the best interests of the community.

H. HEWITT
Thorn Electrical Industries Ltd.

The 1961 edition of the IES Code may turn out to be an historic document. Whilst recommended illumination levels have not been radically altered, the establishment of 15 lm/ft² as an 'amenity level' means that we are beginning to ask a new question; for we are not now asking what illumination people need but what illumination people want. Having once admitted this as a valid question, there may be far-reaching developments in future issues of the Code.

Secondly, the new section of the Code dealing with the limitation of glare can be regarded as a milestone in the history of lighting. The routine called for may not be perfect, and experience with the Code will probably still teach us some useful lessons. In particular it will not always be easy to classify fittings, but this glare system will certainly be effective in dealing with the primary qualitative fault in interior lighting.

It will make the lighting engineer think more about the choice of fittings in relation to the function of an interior. He must think more about the orientation of the fitting, its height and its relationship with reflection factors. The Code may even encourage architects and those who control interior decoration to decide their reflection factors sufficiently early to provide the essential data which must be available to operate the Code.

The fittings designer must know how to control the brightness of fittings at significant angles. There are a number of approaches to this problem and the choice of method may sometimes be determined by economics, sometimes by engineering requirements and sometimes by appearance.

The user of lighting will find the new issue of the Code to be a document that will show him how to choose and value his lighting and how it can be influenced by good maintenance and correct décor.

REACTIONS TO THE NEW CODE

T. S. JONES
Crompton Parkinson Ltd.

The issue of the new IES Code is a major event in the history of the Society; synthesis of so much work into such positive recommendations reflects great credit on all those responsible.

Part I of the Code usefully summarises many of the factors which require constant reference by the young planning engineer and which also can be used to support recommendations made to users who otherwise may still consider intensity to be the main criterion by which recommendations should be judged. Perhaps the paragraphs dealing with stroboscopic effects indicate that these difficulties are more real than experience suggests and although the reference to flicker is fair, the standardisation of bi-pin caps for fluorescent tubes has perhaps reduced the need for end shields.

Part II of the Code is excellent as it provides a logical and well reasoned lead into the use of British Zonal Classifications for lighting fittings and into the method of assessing acceptable limits of glare in a most practical manner. It is interesting to see that the recommended values of illumination in Part III are given in the logical visual steps which can be fully justified by authoritative published work here and abroad: the fact that the resulting figures are reasonable will be welcomed by many who may have feared that commercial bias would have influenced the tables. Comments of our overseas friends will be awaited with interest. Combining the figures for illumination with the limiting Glare Index should result in generally improved standards of lighting quality for both industrial and commercial work.

The new generation of lighting engineers will soon accept the Code and its implications: perhaps some of us, the older generation, will indulge in a little private intensive study if only to save our blushes: some re-education and practice is needed to become familiar with the new methods suggested in the Code and to ensure that all its implications and excellent suggestions are properly absorbed.

To put a cost on the immense amount of work which production of the Code represents must indeed be difficult as calls have been made upon the time of so many in public and private service with the knowledge and experience necessary for the task, but it is, I think, fair to say that the results more than justify the effort made and the document should greatly enhance the standing of the Society both nationally and internationally.

H. R. RUFF
AEI Lamp and Lighting Co. Ltd.

The effort made by the Illuminating Engineering Society to make such drastic revisions to their Code should result in real lighting progress. The very format of the new Code suggests the break-away from adequate lighting into an era of gracious lighting.

The original 1936 Code gave authoritative guidance for the elimination of such low levels of lighting as incur danger and overstrain. The cost of lighting is now only one tenth of what is was then. With this economic advantage in mind the Society has now introduced a minimum amenity level which will ensure the elimination of the unpleasant atmosphere of gloom which can result from mere adequacy. In addition, it has been practicable to raise the illumination for the more difficult tasks to ease the fatigue of their fulfilment.

The provision of better lighting through the use of higher intensities has been gravely hampered by the lack of understanding of the control of glare. Good lighting, including the control of glare, entails the concept of the design of the whole visual field. 'Brightness engineering' is still too complex for general acceptance and is at present mainly the prerogative of the research and development lighting engineer, but a real step forward has been made from the use of simple coefficient of utilisation tables to values taking care of the control of upward as well as downward lighting, and by bringing to the Code new light distribution classifications. The introduction of tables of glare index values should help to put into perspective the factors affecting glare for those designing good modern lighting installations.

The elimination of glare can be taken to such extremes that monotony can result. As 'one man's glare is another man's sparkle', there must be some personal preference in the compromise between the liveliness of a lighting installation and the ease of carrying out tasks under that lighting. The design of satisfactory lighting installations still needs the advantage of experience and artistic perception, but the inclusion of these modified lighting levels and particularly of the limiting glare indices should result in a reduction of the number of installations which do not reach the standard of good lighting at which they are aimed. Such problems can, for example, arise when a user, after seeing a particularly interesting and attractive fitting in one office, suggests using it under very different conditions; this may result in undue glare. This can now be checked straightforwardly using the new Code recommendations.

A most important reaction on the design of lighting equipment will be the correlation of the polar distribution of light from fittings with the type of installation which they can most economically serve, so that with amenity levels of lighting, glare will be under control. This should stimulate the advancement of good lighting practice.

The Code also introduces the concept of adequate supplementary lighting. The difficulties in reconciling economic building construction with daylighting giving an adequate light distribution for working over the full room area, while at the same time avoiding excessive heat loss in winter and excessive solar gain in summer has led to the general use of artificial lighting during the day in most of our factories and offices. Much of such present lighting is ill-planned. By advising that the provision of some 50 lm/ft^2 at the remote end of a room can make a whole room appear well lit and enable many tasks to be performed well over a wide area, the Code introduces an important new aspect of lighting, and its reaction on architectural progress should be most important. With the continued improvement in performance of fluorescent lamps, some efficiency can now be bargained for truer colour rendering of natural objects; it may well be that one of the main developments promoted by the new Code will be the elimination of the obviously artificial supplementing of daylight, and the provision of that balance of interior illumination during the day in both factories and offices which is now beginning to provide attractive working conditions.

R. L. C. TATE
Harris and Sheldon (Electrical) Ltd.

There is no doubt that the Code is a most impressive and useful publication, and both in content and presentation is a credit to the Society. The change of emphasis from quantity to quality in lighting is in line with present-day thinking and is most clearly shown in the glare ratings printed beside recommended values of illumination. It seems likely, that in the future, these tables will be as much used as the familiar coefficient of utilisation tables in the lumen method of design, but if this is to happen, it is essential that architects and lighting engineers should become thoroughly conversant with them, and that all fittings manufacturers should publish BZ ratings for their fittings. To do this two things are necessary. First, there must be an educational drive similar to that made by the Lighting Service Bureau before the war, in

Lighting engineers' comments (continued)

which design courses on the lumen method were held all over the country. Secondly, an independant photometric testing station or stations will need to be set up for the use of the smaller fittings manufacturer who cannot afford a photometric laboratory of his own. This has been a crying need for several years, and will not, I fear, be realised until some of the firms concerned unite to set it up.

H. G. CAMPBELL
Benjamin Electric Ltd.

As is well known to illuminating engineers, techniques in the design of fittings and installations are becoming more complex and specialised, and the new IES Code certainly represents a bold step forward in attempting to explain and codify so many of the fundamentals.

As one may expect, the illumination values have risen, but the outstanding feature is the introduction of a method of glare assessment and recommended limitations. The desirability of glare control is undeniable, but the test will be whether such standards prove economically practical compared with what is at present accepted as good practice, particularly in view of current trends towards increased illumination values and lower roof and ceiling heights. One cannot help feeling that the limitations may readily prove more restrictive than has been realised. In practice, particularly in industrial work, one often lacks the flexibility in the positioning of fittings that the Code appears to assume are always available to the lighting engineer. On the whole, the ultimate effect of strict application of the Code will tend to increase the number of fittings required for a given illumination, which may make its exact and correct application in competitive business something of a problem.

If it be assumed that conditions are satisfied by present types of good quality fittings, what direction can be taken by future progress, bearing in mind that lamp lumen outputs and illumination values are both on the increase? The trend for more fittings for a specific illumination follows logically from the very factors involved in making the glare assessment. The greater the light output from a fitting the greater the glare; thus, with a normally acceptable light distribution it might become necessary to reduce the individual light output, in other words, to employ a larger number of smaller wattage fittings.

An alternative would be to employ more concentrating types of reflectors and as this again tends to reduce their individual light outputs, fittings would have to be placed closer together, both to meet the lower performance and to comply with the smaller spacing ratio of this class of fitting —resulting again in more fittings.

There appears yet another possibility, which is to increase the size of the fittings for a given wattage lamp, but with open type reflectors this seems a rather doubtful step despite the glare assessment method, and would of course increase the cost of the fittings.

From the above it will be seen that the future trend is bound to increase the fittings required on a project and add to the installation costs. Of course, it is realised that all advances and quality improvements result in greater costs, but it would appear plain that the impact on the lighting industry of the new desiderata is likely to be much greater than on any previous occasion. Although the final objective is desirable, the interim period before the full acceptance of these standards is likely to be long and fraught with many commercial difficulties.

Philips Electrical Ltd.

For all closely connected with lighting this new Code provides a useful and essential volume of data concerned with lighting design. It is interesting to note that in this new edition particular attention has been given to the computation and control of direct discomfort glare from artificial light sources, and also the basis for determining lighting levels for different occupations. A further matter which has claimed special attention has been that of daylight design and a new approach to daylighting design is proposed.

In the schedule of recommended values of illumination a new range of intensities is given and many of these are of a higher order, thus bringing the schedule up-to-date, by embodying much of the new technical knowledge and experience which has been gained since the previous schedule of values was prepared.

The new Code will be of considerable help to all actively engaged in lighting and should be of special interest to architects, consultants, works engineers in this and other countries.

Particular credit is due to the Members of the Technical Committee of the Society and to the Drafting Committee upon whom has rested the major burden of preparing this document. The Society is to be congratulated for having made a notable contribution in the field of lighting.

Holophane Ltd.

The higher illumination values given in the schedule of the new Code are to be welcomed because they are in accordance with current practice. These higher values make it essential to give more attention to the control of glare and to the maintenance of lighting installations, and we welcome the greatly enlarged sections on these subjects in the present Code.

Part I and Part II of the Code are largely concerned with quality, both in the quality of the lighting in revealing form and texture and the appearance of the lighting installation in avoiding discomfort glare. These criteria call for directional control of the light on to the work rather than into the eyes.

The three full pages on maintenance give much more detail than in previous issues of the Code, as is necessary with the higher illuminations now generally adopted. More light usually means greater cost, and deterioration is therefore more expensive; this is likely to lead to the design and construction of fittings of more durable or more readily cleaned components.

The Code's glare index system is based on a large number of conventions and assumptions, but even so it seems to work very well. It is to be welcomed as a discipline in fittings design, because it is bound to encourage the development of good designs and it is much better than the old arbitrary limits of luminance which ignored many other factors having a great influence on discomfort glare. The emphasis on end-wise and cross-wise viewing of elongated fittings is perhaps too great, because with proper control of the polar curves the initial glare index can be the same in either direction; for example, a louvered plate designed on strict optical principles gives exactly the same glare control in either direction and renders the additional conversion factors unnecessary. The present system may be refined with greater experience, and we hope that it will be possible to extend it to include luminous ceilings or north-light roofs, and to cater more precisely for some of the rather extreme contemporary fittings which may have excessive intensity at high angles even though their general distribution is in a low BZ classification.

Colour rendering and permanent supplementary artificial lighting are problems which are always with us, and the guidance given on them in this Code is not very precise. These two problems are of fundamental importance in good lighting, and we look forward to more information being available for the next issue of the Code.

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(1) An office installation which appears to comply with all the Code's major recommendations; the design of the fittings is such that in these surroundings the glare index will be acceptable; attention has also been paid to achieve a high ceiling brightness whilst the light desk tops make for a good surround brightness to the task.
(2) This office has been selected not so much for the use of recessed fittings (which will probably result in an acceptable glare index) but to illustrate the lack of wisdom in using dark polished desk tops, in which reflected glare is particularly noticeable.
(3) Part of an interior devoted to processing tobacco; in such areas, the type of fitting illustrated, in which the trough reflector gives a good cut-off, will probably result in an acceptable glare index irrespective of the line of sight.
Below, another light engineering works using trough reflector fittings, as arranged, across the line of sight, they are likely to give acceptable glare conditions. It can also be mentioned here that inherently cut-off fittings should also arrange to provide some upward lighting to ensure reasonable background brightness.

Lighting engineers' comments (continued)

WALTER BOISSEVAIN
Merchant Adventurers Ltd.

The new IES Code is to be welcomed for a number of reasons, particularly as a breakthrough has been achieved in simplifying brightness calculations.

The recommendations for higher illumination values reflect the increase in the standard of living and technical achievement. We are used to and appreciate very high levels of natural daylighting and the only limits to achieving the same levels artificially are cost of current, lamp replacement, equipment and maintenance on larger installations, plus the increased technical skill needed to reduce glare and achieve visual comfort. Therefore, these higher levels are a step in the right direction.

The new Code wisely recognises that with higher levels of illumination, the whole question of brightness control becomes much more critical, and the brilliant simplification of the calculations involved removes a number of difficulties in applying the Code. It has always been a much simpler matter to provide the correct level of illumination than to control brightness, and the great emphasis that has now been placed on glare is of the utmost importance. Until this factor has been mastered completely it will not be practical to aim for the still higher desirable lighting levels. The task is now for the manufacturers to develop new ranges of luminaires with a much higher optical control of light, and for lighting engineers to develop skills in using this equipment to provide a new standard of visual comfort.

R. A. HOUNSLOW
Falk Stadelmann and Co. Ltd.

This new IES Code is a valuable handbook; undoubtedly an enormous amount of work has gone into its compilation. It could have been no easy matter reconciling different schools of thought, particularly in the sections dealing with glare.

The illumination levels are recommended values and should not be misinterpreted as legal minima. It would not be good practice anyway to work down to a minimum but if for any reason minimum values have to be referred to, other than those laid down by statutory regulations, then the recommendation in Part I, Section 2. 2, of 'not less than 15 lm/ft²' is sensible. In contrast it cannot be over-stressed that for the glare system to work satisfactorily the index values given are maximum limits and there is no tolerance permissible. It is hoped that Section 10, 'Determining Illumination Levels', with its relevant formulae and nomogram, is a very satisfactory replacement for the old Code's 'Block Graph' which could be interpreted as giving wide plus and minus tolerances for a given recommendation. The heart of the Code could be said to be Section II, 'Assessing Direct Glare', and the IES Glare Index System, but without the Technical Report No. 2, which has yet to be published, it would not be fully workable or understood by those who have not been suitably briefed. It is to be hoped that this Report will be treated as a matter of urgency. Nevertheless, the Code offers an authoritative system, although many will have reservations of one sort or another as to the way in which it is applied. My feeling is that all lighting engineers should adopt the system as it is set out for a period of at least five years after which sufficient experience should have been obtained to show what, if any, changes are needed. All all events, we are on the right road.

The manufacturers of lighting equipment will have to do more work in their photometric data computing sections. All this costs money. The lighting industry is not so profitable that we can be expected to provide data ad lib for conflicting systems. My company will support this Code and its implications.

Having said this, one or two reservations must be made. The provision of the BZ Classification, coupled with the relevant room index, direct ratio, and ceiling ratio figures, cannot be immediately provided for an extensive range of lighting fittings. What we shall endeavour to do is to provide the relevant data as a matter of course for all new equipment as it is issued. Obviously time is required to extend these data to established equipment.

REACTIONS TO THE NEW CODE

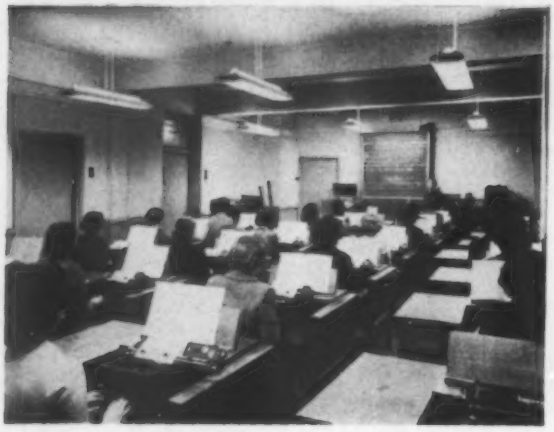
Architects' comments

ARTHUR LING, BA, FRIBA
Coventry City Architect

I think the revised Code should prove very useful as a basic document for all those concerned with the design of buildings and I am glad to see that it is based on an integration of natural and artificial lighting. I am still old-fashioned enough to think that natural light is preferable to artificial lighting and I therefore view with some supicion the contents of Section 13 which deals with designing for permanent supplementary artificial lighting. There is a growing tendency to talk in terms of buildings both artificially lighted and artificially ventilated and this could be to the detriment of the occupants if it is based on an over-exploitation of the site. I appreciate that it is not the intention of the Code to encourage this but the architect should aim to eliminate 'dark and gloomy corners' in his design rather than rely on supplementary artificial lighting.

On the other hand, I am very much in favour of the proposals, put forward in some detail, for eliminating glare in buildings. So often it is impossible economically to provide for windows on more than one wall of a room and this means that the light source is entirely from one direction and glare is almost inevitable. The same defect can be created by lack of balance in the sources of indirect lighting, particularly when lighting conditions in a building are subjected to influences of fashion and current research. It is useful in these circumstances to have a basic scientific document such as the Code to which one can turn for a re-assessment of principles.

The complaint in the past has been that the level of illumination is inadequate for efficient working. Now, I fear, the tendency is to go to the other extreme and certainly in the lighting of shops as seen from the exterior there has developed a competition which is giving our cities a brash, restless character which we certainly do not wish to see inside our buildings. The starting and finishing point for all our researches into the principles of good lighting should be the effect on people, and lighting not only enables people to see well without strain of any kind but it also has an aesthetic value which gives what the Code aptly describes as 'a pleasant environment conducive to interest and a sense of well-being'.



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(1, 2) Before and after the relighting of a commercial school classroom. The original installation was obviously defective in every way (although its counterparts are still to be found); the replacement probably achieves acceptable glare conditions, since the fittings are parallel to the normal line of sight.
(3,4) Another contrast in office lighting: the upper picture illustrates the installation of diffuser fittings across the line of sight, which conditions are less likely to result in acceptable glare than mounting along the line of sight, as in the lower picture.
Left, the use of recessed trough fittings in this office has probably given satisfactory glare conditions, particularly in view of the generally light and airy character of the interior with its consequently high background brightness.

REACTIONS TO THE NEW CODE

Architects' comments (continued)

BRYAN WESTWOOD, FRIBA
Bryan and Norman Westwood and Partners

Although one may be inclined to assume that a code is purely a factual affair, the very title of this one suggests an element of subjectivity. It contains its share of technical tables, but its value lies in its realistic blend of physical fact and aesthetic requirement. In the first paragraph, for instance, one of the aims of good lighting is stated to be ' . . . to create, in conjunction with the structure and decoration, a pleasing environment conducive to interest and a sense of well-being'. All through the text factors outside the scope of tables and formulae are kept in sight.

Part I deals with the principles of good lighting. The importance of the ratio between background lighting and the concentrated light on a 'task' is well brought out and many other aspects of the subject which one has half grasped are admirably clarified.

Part II on aspects of design has useful data about methods of supplementing daylight, but is mostly concerned with glare. The extensive and highly technical tables dealing with glare seem to warrant much more by way of definition than the brief note in the glossary. These tables are obviously the essence of the document, but not being a physicist I am sceptical as to their real value for general use. They seem to me to imply a degree of accuracy inappropriate to the study under review, which is too complicated by subjective factors to be amenable to mathematical precision of this order. It is a matter of common experience that even people doing identical tasks habitually, week in and week out, have very different ideas about this vital tool of their trade—the right light for the job. As a practical point, I would say that the procedure involved is too exacting for anyone other than a lighting expert.

In the text itself I would criticise only the emphasis given to the subject of the elimination of contrasts. I agree in principle with what is said, but of course the use of contrast with understanding is the very essence of decorative lighting. A casual reading of the text might give encouragement to those who already provide the monotonous lighting we see in many buildings. This can come about by raising the general level so high that noticeable contrasts are impracticable to attain. I think also that differences of light in rooms and corridors are valuable in providing variety of lighting. Surely it would be quite exceptional to find a contrast between such areas that was great enough to become dangerous?

In Part III there is a schedule of recommended values of illumination followed by a glossary and bibliography. The first and the last appear to cover what one might need to know, but as an architect I wish the glossary were more informative. Architects have to cover such a range of information in the course of their work that they must be pardoned if they welcome full definitions of words such as 'glare', 'flux', 'upper hemisphere', and would like to have a concise list of definitions of any units they may come across in connection with lighting.

In conclusion, it should be understood that my criticisms spring from a special slant on the subject. I think that the Code is a model of its kind, with a welcome acceptance of aesthetic factors.

G. GRENFELL BAINES, OBE, FRIBA
Design Partnership

Architects who still hold hopes of a happy marriage between artificial lighting and the interior forms of buildings will find grains of encouragement in the new IES Code. Naturally, a very large part of it is devoted to the functional and technical aspects of lighting, the language, mathematical formulae and graphs of which emphasise the highly technical nature of the problem and the intense pre-occupation of lighting engineers with the functional aspects of their job.

Nevertheless, it is encouraging to note that in the short space of time from 1936 to the present day, the original Code entitled 'Recommended Values of Illumination', has been widened and expanded to include a section on Form in the Surroundings. In the Preface we are told that while the Code relates mainly to the 'lighting of working areas', guidance is also given to 'some aspects of lighting in churches, stores and similar buildings, but it is recognised that aesthetical considerations lie outside the scope of a Code'. True, but there are people who can be articulate about subjective matters and in praising the present Code and recommending it to Architects one cannot resist expressing the hope that the section 'Form in the Surroundings' will be expanded in the next edition, perhaps as a result of collaboration between lighting engineer and architect.

G. DAVIDSON
T. P. Bennett and Son, FFRIBA

The new Code is direct evidence that the influences affecting artificial lighting since the last war are coming into effect. Cheaper light, greater prosperity and the needs of commerce have combined to direct artificial lighting to higher common levels. Not the least of the influences is, no doubt, the experience of the draughtsmen and craftsmen who go shopping with their wives in the latest self-service stores on Saturday under an artificial intensity of up to 100 lm/ft² and then find their drawing boards and benches dimly lit (by comparison) on Monday morning. Full employment conditions also make it necessary to attract staff by raising working standards.

The architect sees the provision of lighting facilities from two points of view—the client's needs and the appearance of the building interiors—and is conscious that comfort in seeing with artificial light means pursuing the characteristics of daylight to which vision is chiefly attuned—very high intensities can be enjoyed if the diffusion is adequate, if glare can be avoided and if contrast can be kept within limits.

The section on designing for daylight will be very instructive and useful for architects in particular. The principle of permanent supplementary artificial lighting for daylight is one which deserves special attention and will no doubt be widely adopted in future. It will certainly ease some of the architect's problems in providing adequate daylighting, but unless suitable automatic control is incorportaed in the installation it may lead to staff dissatisfaction where the design intensity is lower than the supplementary intensity, for human frailty will not always ensure proper discretionary manual switching control at dusk.

The new recommended minimum value of 15 lm/ft² for amenity lighting will be questioned by many where the previously accepted minimum of 6 lm/ft² has been found adequate and contrast is not a problem. The increased illumination standards will take time to become widely adopted on account of the economics involved. Revolutionary changes are in any case always opposed especially by large economy-minded organisations which are well satisfied with their existing lower standards. However, in view of American standards generally, and some multiple stores in this country, the recommended illumination values in the Code on the whole can be said to be quite moderate.

Architects' comments (continued)

EDWARD D. MILLS, CBE, FRIBA

The complication of a Code for good interior lighting involves many factors besides artificial lighting. The Committee of the Illuminating Engineering Society responsible for the new Code have appreciated this fact and have considered both artificial and natural lighting problems, but it is surprising that they do not deal with the allied subject of colour in buildings which can play an important role in relation to lighting. The new Code is, however, a valuable document which will be of great assistance to architects. The general presentation has been designed to ensure that it will be regarded as a working tool. The various sections are clearly marked, but a comprehensive index would have made reference considerably easier.

A good deal of the Code is rightly devoted to the problems of glare and its control. This is especially important as most of the Recommended Values of Illumination given in the schedule have been increased very considerably over those given in earlier editions of the Code; indeed, some of the Recommended Levels appear to be on the high side. In this connection some notes on the design of lighting fittings with this problem of glare in mind, would have been a valuable supplement to the section on glare. Table 3, dealing with Initial Glare Indices (page 23), refers to 'fittings with well designed louvers', but does not lay down any principles upon which the design of such fittings should be based.

The Committee have appreciated the importance of designing for daylight, and a very useful section of the Code (Section F) outlines the essential consideration; this is followed by a section concerned with artificial lighting designed as a permanent supplement to daylight. This is of particular importance and is rapidly becoming an accepted technique for many types of commercial and industrial buildings. It is surprising that no reference is made to the special problems attached to the design of the lighting of buildings from which all natural daylight is deliberately excluded. The problems in this field are many and complicated as American industrialists have discovered. This subject should be seriously considered in any future edition of the Code.

In spite of any criticism which can be made of the 1961 Code, it is a valuable and welcome publication, which should be of great assistance to designers concerned with the provision of adequate, comfortable and attractive lighting in their buildings.

REACTIONS TO THE NEW CODE

User organisations' comments

Institute of Directors

It is at last being realised that there is more to good lighting than merely putting a bulb in the middle of a ceiling. More than this, it is now further apparent that artificial lighting cannot be considered in isolation, but that it must be properly planned within the general context of the whole building. Thus lighting schemes must tie in not only with the architectural design for daylighting, but also with the colour schemes and the work to be done in the room. As lighting standards inevitably, and beneficially, go up, glare becomes of increasing importance. Glare control, involving as it does the design and placing of fittings and reflectivity of surfaces, becomes a vital part of lighting control.

The manager of today, of shop, office or factory, has to be a man of many parts. One of his main jobs is to create the optimum environment for the functioning of his organisation. Lighting, of course, plays a major part in this environment.

Until recently, environment control was a matter of rule of thumb and intuition. Now it is possible to set design standards for environmental conditions. Managers can arm themselves with a set of standards and tell their experts to provide them.

We feel sure that this new IES Code which covers virtually the whole range of industrial, commercial and domestic activities will be of the greatest use to industry. The inclusion of glare control and the emphasis on the 'wholeness' of lighting in relation to work, basic design, colour and window design is particularly useful.

Federation of British Industries

We have read the 1961 IES Code with great interest; although we do not claim expert knowledge of lighting applications our experience has led us to appreciate the value of adequate lighting standards from the point of view of quality of production and productivity.

It can be stated in broad terms that the objects of human engineering are those of human economy and efficiency—of so designing environments such that human activities are carried on with maximum efficiency and with minimum effort and fatigue. The standard of illumination is one of the more important aspects governing the suitability of an environment for a given task or purpose. In many cases fittings or sources are provided to supply adequate light but without regard to the effects the sources may have in terms of glare or other discomfort either of the personnel directly concerned or those in neighbouring zones indirectly affected.

No two cases are alike and each set of circumstances requires treatment on its merits. The new Code provides an excellent statement of principles on which to base design. It is hoped that this book will receive the attention it deserves.

Royal Society for the Prevention of Accidents

The appearance of this revised edition of the IES Code should be welcomed by every industrial safety officer, for his experience tells him that good lighting criteria are frequently necessary as checks on an important aspect of his job. This Code provides him with an intelligible work of reference which he can, as the Preface suggests, use as a guide without being hamstrung by dogmatic conclusions. This is also discernible in the section dealing specifically with safety, where lighting requirements in a situation to be regarded as safe are frequently higher than that merely necessary for visual efficiency. The information on glare will also be received with gratitude, even by those who though outside the intended readership of the book in such situations as building and construction sites, will find acceptable standards on which to work. Whatever the industry, it is not overstating the Code's value to say that no safety officer can afford to be without it on his bookshelf.

LIGHTING ABSTRACTS

LAMPS AND FITTINGS

963. Plastics, yesterday, today and tomorrow. 621.329

C. L. CHILD, *Trans. Illum. Eng. Soc.* (*London*), **26**, 33–42 (No. 1, 1961).

The history of synthetic plastics stems from the discovery of nitrocellulose ('Celluloid') about 100 years ago. Since then very many developments have taken place in the synthesis of new plastic materials and fabricating processes. Even so, at the present time only about a score of plastics are of commercial importance. New materials of greater stiffness and higher softening points are polypropylene and the polycarbonates, both of which are likely to be utilised by the lighting industry in the next few years. P. P.

964. Progress in electric lamps. 621.32

H. G. JENKINS, *Trans. Illum. Eng. Soc.* (*London*), **26**, 17–28 (No. 1, 1961).

In recent years tungsten lamps have undergone changes in terms of reduced bulb sizes and different bulb shapes. Projector lamps of low wattage and voltage but high intensity have been achieved by integral optical systems. The application of the tungsten-iodine cycle has resulted in very small lamps of high intensity and excellent lumen maintenance. The 5 ft, 80w tube remains the most popular British fluorescent lamp. Its luminous efficiency has been improved in recent years by careful selection of the phosphor particle size. Other fluorescent lamp developments include very high loading, compacting the discharge arc and the introduction of low voltage cathodes. Recent advances in the design of high-pressure mercury-vapour lamps, sodium lamps and xenon lamps are also referred to. P. P.

628.971.6

965. Derivation of the curve of luminous flux for a fitting from the illumination curve at ground level.

K. F. STUBERT, *Lichttechnik*, **13**, 56–57 (*February* 1961). *In German.*

The average illumination of a street surface is found most simply from a curve which gives the percentage flux reaching the surface of any street in terms of the ratio of the street width to the mounting height. This curve can be derived from the illumination curve on a horizontal plane at a given distance below the fitting. The method can be adapted for use where the light distribution from the fitting is asymmetrical. J. W. T. W.

LIGHTING

628.971.6

966. Surfaces, seeing and driving: some recent studies.

J. M. WALDRAM, *Public Lighting*, **25**, 249–260 (*December* 1960).

The first part of the paper discusses in detail the changes which now appear necessary in street lighting techniques to meet the difficulties set up by the use of new methods and materials in road surfacing and their effect on street lighting. Suggestions are made as to how these difficulties can be overcome. The second part deals with the mechanism of seeing in daylight and on lighted streets, and describes experiments to determine the reaction of experienced vehicle drivers to various traffic conditions and recorded such reactions on tape recorders. Films were made to synchronise with the recordings and the whole put together to make a most interesting study. The author emphasises the effect of hazards on the route which could impare the efficiency of any lighting installation. He suggests that future installations will probably be of higher mounting, but of similar spacing to that in use today, of more power but with less glare to cope with the darker surfaces now generally in use. He suggests that road margins should have at least as much attention as the carriageway; that street lighting should be beyond criticism where heavy traffic is usual and visual demands acute, but it seems that drivers can cope effectively in a lower standard of lighting where the demands on vision are less. The experiments of co-relating vision with spoken commentary are to be continued under other driving conditions. B. C. O.

967. Progressive changes in public lighting. 628.971.6

T. M. LAPPIN and H. ROBERTSON, *Public Lighting*, **25**, 274–283 (*December* 1960).

Describes the changes and developments of street lighting in Dundee having regard to British Codes of Practice and the availability of modern light sources. The general trend is towards greater mounting heights and one of 35 ft has many advantages. The authors do not favour an intermediate mounting height between 15 and 25 ft. They quote costs and savings made in Dundee by changing from high wattage tungsten filament to fluorescent-bulb mercury lamps and describe various installations now in being. They also quote their experiences to date with the linear sodium lamp. They discuss the problems of aesthetics in special districts but conclude that whilst due regard should always be given to appearances, the technical and economic consideration should have precedence. Whilst the paper concentrates on Group A lighting the authors point out the importance of providing adequate Group B lighting should not be forgotten. B. C. O.

628.976

968. Lighting of building sites for constructional and allied work.

H. OLENIK, *Lichttechnik*, **13**, 13–15 (*January* 1961). *In German.*

After a general discussion of the requirements, including safety measures, the author describes the use of floodlighting equipment for illuminating large sites where building is in progress. Colour-corrected mercury lamps have the advantages of long life and high efficiency. The absence of colour discrimination militates against the use of sodium lamps. J. W. T. W.

969. A note on quantities of light. 535.241

J. G. HOLMES, *Trans. Illum. Eng. Soc.* (*London*), **26**, 47–50 (No. 1, 1961).

The Lighting Design Data Panel of the IES Technical Committee is on the point of issuing a Technical Report concerned with the calculation of the utilised flux in a lighting interior. The terminology used in the calculations, and the various components of the light flux, are the subject of the present note. A more practical meaning for the term 'light output ratio' is offered, the usefulness of the concept 'utilance' is considered and the alternative terms 'utilisation factor' and 'coefficient of utilisation' are discussed. P. P.

970. Rationally recommended illumination levels. 628.93

H. C. WESTON, *Trans. Illum. Eng. Soc.* (*London*), **26**, 1–11 (No. 1, 1961).

Five general criteria, which at one time or another have been used as the basis for determining recommended illumination levels, are discussed. Recent new American and Russian recommendations, together with their associated experimental work, are critically examined. The desirability for having an 'amenity luminance' is considered. A simplified method is proposed, based on the author's earlier visual performance studies, for specifying recommended illumination levels which, by adopting a higher performance criterion, would result in a moderate general increase in the current recommended levels. P. P.

971. Lighting—keyed to today's homes. 628.972

Illum. Engng., **55**, 638–654 (*December* 1960).

This last instalment of a three-part report (*IE*, October, November and December 1960) on the artificial lighting of dwellings deals with actual examples of lighted interiors, outdoor living and gardens, dimmers for light control and light sources. The lighted interiors each incorporate several types of lighting, with fluorescent lighting providing the background or general illumination and incandescent filament lighting used at specific seeing locations and for decorative accent. P. P.

972. Engineering designs for residential lighting. 628.972

N. FALK, *Illum. Engng.*, **55**, 656–662 (*December* 1960).

Conventional illuminating engineering techniques for specifying the light output from fittings has now been applied to a number of refractor fittings intended for domestic use. Comparisons are made with more commonly used diffusing fittings, using polar curves, isolux curves and photographs of fittings cross-sections. Other photometric data demonstrate increased coefficients of utilisation, reduced luminances in the 'glare' zone and more upward light for the refractors in comparison with common residential diffusers. P. P.

THE IES ANNUAL DINNER

Criterion Restaurant, London, April 12

Our heading illustration shows Dr and Mrs Stiles with the Society's principal guests at the dinner: on the left Sir Robertson and Lady King, on the right Dr and Mrs F. M. Lea. Below, top left: C. J. W. Scott (Chairman, Electric Lamp Industry Council), J. H. Hirst (President, Electrical Wholesalers Federation) and C. R. Waterhouse (President, Electrical Contractors Association) with their ladies; top right: Dr F. M. Lea (Director, Building Research Station), Mrs Lea, Frederick Gibberd (Vice-President, Royal Institute of British Architects), Mrs Gibberd, with W. T. Souter (President-Elect, and Chairman of the British Lighting Council), Bottom left: André Boerebohm with Mrs Souter, G. F. Cole (Secretary) and Mrs Cole, Mrs Ballin and Dr H. H. Ballin (Chairman, Lighting Equipment Development Council); bottom right: A. G. Penny (Honorary Secretary) Mrs Penny, Lady Sutton, H. G. Campbell (Immediate Past President) and Sir Graham Sutton (Director-General of the Meteorological Office).

THE ANNUAL DINNER of the Illuminating Engineering Society, the gala occasion in the IES year, was the conclusion of two hectic days for the Society, being held the day after the Code meeting attended by the Duke of Edinburgh and having followed a Council meeting earlier that day. The Dinner, which took place at the Criterion Restaurant, was attended by 280 members, guests and ladies,

In proposing the toast to the Society, Sir Robertson King, CBE, Companion IEE, MInstF,Chairman of the Electricity Council, started by recalling some of the early days in the history of lighting, when it was considered a relatively easy task to sell electricity for lighting—it had no real competitor, except gas. He felt that it was a pity that electricity came to be regarded as a replacement for gas; the contractor was left to put a hole in the ceiling adjacent to the existing gas fitting in order to be as near as possible to the centre of the room. We were, he continued, still living that down today when we find that Council houses are provided with 3 power points and 8 lighting points, the latter usually centrally located suspended lights. Fortunately there was a growing tendency to spread light around the room, and to provide it where it can be used to best advantage.

He then referred to the previous evening's event, expressing the thought that the new Code was going to revolutionise lighting in this country. Of particular sig-

Three distinguished research scientists in public service, bringing together the contrasting interests of roads, light, and meteorology: Sir William Glanville, CB, CBE, DSc, FRS, Dr W. S. Stiles, OBE, DSc, FRS and Sir Graham Sutton, CBE, DSc, FRS

nificance for him was the permanent use of artificial lighting to supplement daylight and he wondered whether p.s.a.l. might not provide at least part of the answer to the supply industry's load factor problem, which would become even more pressing once nuclear power stations came into operation. Electricity was cheap and if it was possible to induce the working man to realise that he can have two or three times the light he now gets for an extra cost of only 3*d*. or 4*d*. per week, the Society will have accomplished one of its tasks and the supply industry would be a lot happier.

In response, the President, Dr Stiles, OBE, DSc, FRS, was quick to acknowledge that the Society had acquired a magnificent ally in the previous speaker. He suggested offering him a permanent season ticket to all future dinners for his remarks on the possible effect of the new Code on the load factor. His theme, in general, was the Society's stock-taking over the last year to determine how it would meet the demands to be placed upon it in the near future as a result of technical advances and development of the industry. The review had been a sobering experience with a number of headaches; it had made clear that considerable effort was going to be needed to ensure that the part played by the Society in the life of the community will expand at the same rate as that of lighting development generally. The first major part of implementing the Society's policy of controlled expansion was the acquisition of *Light and Lighting*: the aim was now to see that its quality continues and its circulation extends to a much wider field. On the technical side, the Society was in a healthy position; apart from the new Code, the Technical Committees had also been preparing two technical reports which will appear shortly. Dr Stiles continued by paying warm tribute to Dr Harper for his part in the Code's preparation, crowned by the brilliant lecture, which the Duke had told him he had much enjoyed. He concluded with the surprise announcement that at the morning's Council meeting, it had been decided to elect Mr Weston as the recipient of the Society's second gold medal for his work on lighting and vision.

The Immediate Past President, Mr H. G. Campbell, TD, MA, proposed that difficult toast 'The Guests', with a most gallant welcome to the ladies. Few took seriously his light-hearted suggestion that, in view of their interest in home lighting, they should take a more active part in the Society's technical discussions. Responding, Dr F. M. Lea, CB, CBE, DSc, Director of the Building Research Station, expressed appreciation of the Society's nice sense of balance, a characteristic of their activities notably evident in their guest list. It brought together a diversity of seemingly contrasting activities all having in common some pre-occupation with lighting, whether natural or artificial.

At the top table, Sir Robertson King chats with Dr W. S. Stiles, Dr F. M. Lea with Lady King and H. G. Campbell

From left to right, Mrs Scott, C. J. W. Scott, A. W. Gostt, Mrs Gostt, F. C. Smith (President Association of Public Lighting Engineers) and his guest, Miss K. Taylor

IES Gold Medal

H. C. WESTON, whose election as the recipient of The Illuminating Engineering Society's second Gold Medal Award was the surprise announcement at the Annual Dinner, has given distinguished service both to the Society and to lighting generally for the greater part of his career. He is chiefly recognised, of course, for his close association with the IES Code since its first appearance twenty-five years ago, and it is singularly appropriate that he has been honoured in this way at the same time as the publication of the latest Code, particularly as this version, in common with its predecessors, continues to use the relationship between illumination and visual performance which he established from his internationally famous work at the National Physical Laboratory in the years before the war. It is for this sustained effort, which has continued since the war, that he is being honoured. His interest in, and work on, lighting and vision grew from his early study of factors affecting the health of industrial workers, in which field he served with the Medical Research Council (retiring just over a year ago) and for a time as joint secretary with Dr J. W. T. Walsh (the first recipient of the Gold Medal) of the Home Office committee on factory lighting.

Mr Weston was President of the IES in 1945–6 and on retiring from the presidency, he took over the duties of Honorary Secretary, holding that office until 1955. He is the author of a number of works, including papers presented to the Society, the most recent being 'Rationally Recommended Illumination Levels' presented at the last IES Summer Meeting and for which he was awarded the Leon Gaster Memorial Premium.

Forthcoming Events

LONDON

May 9

Annual General Meeting, 5.30 p.m.

What is good architecture by H. Bruce Allsopp, Senior Lecturer in Architecture, Durham University, 6.30 p.m., Federation of British Industries, Tothill Street, SW1.

CENTRES

May 5-7

Week-end meeting, arranged jointly by Edinburgh, Glasgow and Newcastle-upon-Tyne Centres. The new IES Code and its implications, by W. Robinson; Lighting practice and new codes in the USA, by C. L. Crouch. At the Peebles Hydro Hotel, Peebles.

May 12-14

Week-end meeting, arranged jointly by Bath and Bristol, Birmingham and Cardiff Centres. The new IES Code, by W. E. Harper; Office lighting, by R. G. Hopkinson. At the Abbey Hotel, Malvern.

National Illumination Committee of Great Britain

REPORT FOR THE YEAR 1960

AT THE ANNUAL GENERAL MEETING in January, the election of officers was held to cover the period until after the next meeting of the CIE in 1963. The Committee of Administration and the NIC/CIE Panel, meeting jointly, made a number of nominations and these were accepted unanimously by the Committee; the list of officers is given later in this report.

A change in the chairmanship was made necessary by the resignation of Dr S. English from membership of the Committee. Dr English was first appointed to the Committee in 1947, and was its Vice-Chairman from 1948 to 1956, its Treasurer from 1949 to 1956 and one of its representatives on the Executive Committee of the CIE from 1948 to 1956. He was the leader of the British delegation to the CIE Sessions in Stockholm in 1951 and Zurich in 1955 and he had also served on the CIE Statutes and Finance Committees. He had thus been extremely active in the interests of the NIC and also of the CIE and the experience which he had gained in the course of this work was put to good purpose when he became Chairman in 1956. The Committee wishes to place on record its appreciation of his long and distinguished services on its behalf.

The AGM re-appointed Mr C. Harper and Mr A. H. Olson as auditors, whilst Mr W. J. Jones, Mr J. F. Stanley and Dr W. S. Stiles were re-appointed to the Committee of Administration. As regards the NIC/CIE Panel, the new Chairman was appointed in place of Dr English and the former members were asked to continue to serve until such time as the functions and possible constitution of the Panel had been considered by the Committee of Administration. These members were Mr A. G. Higgins, Dr W. E. Harper, Dr R. G. Hopkinson, Mr J. G. Holmes, Mr A. P. Pott, Mr M. D. Stonehouse, Mr J. M. Waldram, Mr H. C. Weston and Prof W. D. Wright. Also at the AGM, the Committee confirmed the suggestions made by the NIC/CIE Panel regarding nominees to CIE Committees of Experts; the list is given in the accompanying table.

As regards secretariat committees, the following new chairmen of sub-committees were appointed: Mr C. Dykes Brown for industrial lighting, Mr D. W. Tyrrell for the lighting of public buildings and Dr C. A. Padgham for lighting education in schools. Dr W. E. Harper was appointed the chairman of a new sub-committee on the characteristics of materials used in lighting. All other chairmen were re-appointed, but in view of impending changes in the organisation for committee work, no detailed list is given in this report.

Further consideration has been given by the Committee of Administration to changes in the Rules; in view of the significant nature of some of the changes contemplated, the members of the NIC/CIE Panel were brought into consultation. The changes suggested have been agreed by the Committee. In the first place it was considered that the period was too long between a CIE Session, usually held in June,

NIC Nominees to the CIE Committees of Experts

CIE REF.	SUBJECT	SECRETARIAT COUNTRY	EXPERT (C—CHAIRMAN; M—MEMBER; Co—CORRESPONDENT; S—SECRETARY)
E-1.1	Definitions, Vocabulary	France	Mr R. G. Horner (M)
E-1.3.1	Colorimetry	USA	Prof W. D. Wright (M)
E-1.3.2	Colour-rendering	Germany	Mr G. T. Winch (M)
E-1.3.3	Colours of light signals	GB	Mr B. Boorman (C) Mr A. T. Vulliamy (S)
E-1.4.1	Photopic and scotopic vision	USSR	Dr W. S. Stiles (M)
E-1.4.2	Visual performance	Holland	Mr H. C. Weston (M)
E-2.1.2	Sources of u.v. and i.r.	Germany	Mr H. R. Ruff (M)
E-3.1.1.1	Predetermination of illumination and luminance	France	Mr W. Robinson (M)
E-3.1.1.2	Causes of discomfort	USA	Dr R. G. Hopkinson (M)
E-3.1.1.3	Pleasantness in lighting	Holland	Mr H. Hewitt (M)
E-3.1.9.2	Lighting for photography etc.	GB	Mr W. R. Stevens (C) Mr K. R. Ackerman (S)
E-3.2	Daylight	Australia	Mr P. Petherbridge (M)
E-3.3.1	Street Lighting	Belgium	Mr J. M. Waldram (M)
E-3.3.2.1	Aviation ground lighting	GB	Mr E. S. Calvert (C) Mr N. F. Hildyard (S)
E-3.3.3	Airborne lighting etc.	USA	Mr P. F. Cook (M)
E-3.3.5	Automobile headlights etc.	France	Dr J. H. Nelson (M)
E-3.3.7	Signal lights	Germany	Mr J. G. Holmes (M)
E-4.1.1	Lighting education in schools	Switzerland	Mr G. W. Milburn (Co)

* The NIC is affiliated to the International Commission on Illumination. This report was approved at the annual general meeting held on Thursday, January 26, 1961.

and the meeting in the following January at which NIC officers, etc. were appointed and nominations made to the CIE. Accordingly the committee year will now begin on October 1; the ensuing 'year' will therefore commence on January 1, 1961, and end on September 30, 1961.

Secondly, it has been felt for some time that there were several people whose knowledge and experience would be of particular value to the Committee, but who were not likely to be appointed to the Committee as representatives. Accordingly the constitution of the Committee was extended to include three persons of this description to be appointed by co-option. So far, two such appointments have been made and Mr R. G. Horner and Prof W. D. Wright are now members of the NIC.

In the third place it has been decided to enlarge the membership of the Committee of Administration, and to include in its terms of reference the functions previously carried out by the NIC/CIE Panel, which has therefore been disbanded. The enlarged Committee of Administration has six members, instead of three, appointed by the NIC, whilst three more could be co-opted by the Committee of Administration itself. The six members appointed by the NIC were: Dr Hopkinson, Mr Jones, Mr Stanley, Dr Stiles, Mr Weston, Prof Wright; no co-option has yet taken place.

The Committee of Administration, meeting jointly with the NIC/CIE Panel, has also given consideration to the NIC committee structure, with special reference to the most effective manner of organising participation in the work of the CIE. A scheme which was prepared in connection with the four related subjects—photometry, colorimetry, colour-rending, and light and vision —has been put into operation and the NIC has decided in principle to extend the same idea to the remaining subjects of both expert and secretariat categories. In connection with the subjects mentioned, a steering committee on colour, light and vision, consisting of Dr W. S. Stiles (Chairman), Mr H. C. Weston, Mr G. T. Winch and Prof W. D. Wright, has been set up. Its task will be to organise the study of the various aspects of these subjects, as may be appropriate, by the appointment of small panels; it will also be responsible for reporting direct to the NIC. An advisory group consisting in the first instance of all members of the former sub-committees, which have now been disbanded, will meet periodically for a general discussion. An open invitation to all interested will operate for all future meetings of the advisory group. At the end of the year, the Committee of Administration was engaged on the task of applying this general principle to the remaining subjects.

Suggestions were sent to the Central Bureau of the CIE regarding the programme for the Vienna Session in 1963, based on the idea of making the session as short as practicable, with four meetings in parallel and the whole occupying no more than five days. Most other countries, however, preferred the usual length of about eight days and this will be the general arrangement when the CIE next meets in the second half of June, 1963.

The CIE Committees of Experts have been formed and details were notified in a roster issued by the Central Bureau in December; many other details of names and addresses of office holders in all member countries were included. The Committees of Experts on definitions and vocabulary, colour-rendering, pleasantness in lighting and street lighting have met during the year. The Proceedings of the Brussels Session in June 1959 were issued towards the end of the year. During a meeting of the CIE Central Bureau and Scope Committee held in London in October, the Committee was pleased to be able to entertain the visitors to lunch.

The Committee is pleased to record that the British Broadcasting Corporation is now a co-operating organisation, with Mr K. R. Ackerman as its representative. It is with regret, however, that the Committee has to record that the British Electrical and Allied Manufacturers' Association, the Society of Glass Technology and the Nuffield Foundation have ceased to be co-operating organisations. The Institution of Gas Engineers, now a co-operating organisation, is represented only by Mr A. G. Higgins and Mr D. M. Thompson, whilst the Ministry of Transport has only one representative in Dr H. F. Gillbe. The only other change of membership concerns Mr Tabraham who has now been replaced as a representative of the Electric Light Fittings Association by Mr W. T. Souter.

It is of interest to record that the following new British Standards have been issued during the year: BS 1332, *Guide to civil land aerodrome lighting* and BS 1853, *Tubular fluorescent lamps for general lighting service*. The following have been revised: BS 495, *Lamp caps and lampholders for double-capped tubular lamps*; BS 1270, *Schedule for electric discharge lamps for general purposes* and BS 1522, *Schedule of projector lamps*.

W. R. STEVENS, *Chairman*

L. H. MCDERMOTT, *Secretary*

Constitution of Committee, December 31, 1960

Officers

Chairman: W. R. STEVENS

Vice-Chairmen: DR W. E. HARPER, J. G. HOLMES.

Hon. Treasurer: E. B. SAWYER, British Lighting Council, Brettenham House, Lancaster Place, London, WC2.

Hon. Secretary: L. H. MCDERMOTT, National Physical Laboratory, Teddington, Middlesex.

Nominated by the Sponsoring Organisations

Illuminating Engineering Society: G. F. COLE, J. G. HOLMES, L. H. MCDERMOTT, C. C. SMITH, J. M. WALDRAM.

Institution of Electrical Engineers: C. W. M. PHILLIPS, H. R. RUFF, W. R. STEVENS, DR J. W. T. WALSH, G. T. WINCH.

Nominated by the Co-operating Organisations

Admiralty: CAPT G. R. B. PATTISON.

Air Ministry: H. F. INNOCENT.

Association of Public Lighting Engineers: N. BOYDELL, H. CARPENTER.

British Broadcasting Corporation: K. R. ACKERMAN.

British Electrical Development Association: J. I. BERNARD.

British Lighting Council: A. G. PENNY, E. B. SAWYER.

British Plastics Federation: DR W. E. HARPER.

British Standards Institution: J. F. STANLEY.

British Transport Commission: A. H. COLE (*British Railways*), H. E. STYLES (*London Transport Executive*).

Building Research Station: W. ALLEN, DR R. G. HOPKINSON.

Electricity Council: E. C. LENNOX, M. D. STONEHOUSE.

Electric Lamp Industry Council: W. J. JONES, DR J. W. STRANGE.

Electric Light Fittings Association: W. T. SOUTER, J. H. STUDHOLME.

Electrical Contractors' Association: A. H. OLSON.

Gas Council: J. B. CARNE, F. W. SANSOM.

Glass Manufacturers' Federation: D. G. OSBORNE.

Institution of Gas Engineers: A. G. HIGGINS, D. M. THOMPSON.

Institution of Municipal Engineers: C. HARPER.

Medical Research Council: DR W. J. W. FERGUSON, H. C. WESTON.

Ministry of Aviation: E. S. CALVERT, E. G. COOPER, N. F. HILDYARD.

Ministry of Education: G. W. MILBURN, A. P. POTT.

Ministry of Health: D. A. HUGHES.

Ministry of Labour: M. A. MCTAGGART.

Ministry of Power: J. COWAN, H. C. LISTER.

Ministry of Transport: DR H. F. GILLBE.

Ministry of Works: J. B. HARRIS.

National Coal Board: R. BUFFRY, P. N. WYKE.

National Physical Laboratory: DR W. S. STILES.

Post Office: R. S. PHILLIPS.

Road Research Laboratory: G. GRIME.

Society of Dyers and Colourists: K. MCLAREN.

War Office: T. ROBERTS.

Co-opted Members

R. G. HORNER, PROF W. G. WRIGHT.

Representatives of Great Britain on the Executive Committee of the International Commission on Illumination

DR W. E. HARPER, W. R. STEVENS.

House-warming at Imperial College

FACILITIES FOR OPTICAL RESEARCH IN THE NEW PHYSICS BUILDING

AS PART OF the ambitious scheme for extensions to the Imperial College, now well under way at South Kensington, the new Physics Building at the corner of Prince Consort Road and Queen's Gate was opened a short time ago by Sir John Cockroft. This eight-floor building houses the Physics Department of the College, including the Technical Optics Section which is under the leadership of Prof W. D. Wright, an authority of world-wide reputation in the fields of colorimetry and colour vision.

On Tuesday March 7 the Section, which occupies the sixth floor of the building, was 'at home' to a large number of those interested in its work and Prof Wright's welcome and brief introductory remarks were addressed to an audience which filled the Optics lecture room to overflowing. He explained that the aims of the Section were similar to those of the Institut d'Optique at Paris and other kindred organizations, which were to give post-graduate training to those wishing to enter the optical industry and to provide opportunities for research. There were, he said, ten other post-graduate sections in the Physics department (including one on space research) but he felt that optics might claim to have attractions equal to any of them, although it was not always easy to convince students that this was so. He wondered why the British optical industry played such a minor role in the country's economy, as compared with the importance of the industry in Germany, for example. Possibly, he said, the explanation might be found in the fact that it was split into so many comparatively small units.

Prof Wright referred to the establishment of the Optical Design Group by the Department of Scientific and Industrial Research and mentioned that this group was under the direction of Dr C. G. Wynne. He concluded with a brief description of the various items of work currently in progress in the Section and then the visitors dispersed to see for themselves what was going on and to chat to the members of the staff and the students who seemed to welcome greatly the opportunity to explain what they were doing, both to the initiated and to the uninitiated.

One of the larger rooms, with an adjacent smaller laboratory, was entirely devoted to work on colour vision and colour measurement. Much of the apparatus here had been designed, at one time or another, by Prof Wright while working in the old building in Imperial Institute Road. A very topical and interesting piece of research in progress in this room was the subjective assessment of street lighting installations, work which was being carried out under the aegis of the Road Research Laboratory. A large photograph of a street scene with simulated light sources was viewed with one eye, while with the other the observer viewed the comparison field in a modified Holophane lumeter. The outer part of the field was adjusted to have some selected luminance which governed the observer's adaptation level, and the luminance of the central spot was then adjusted to apparent equality with the luminance of the street surface as seen by the other eye.

In another room an extensive investigation of colour vision defects acquired with age was in progress for the Medical Research Council's Committee on Human Factors in Railway Accidents. Subjects were put through a number of tests, including the Farnsworth-Munsell 100-hue test in which they had to arrange a series of twenty-three coloured samples in order of hue difference between two samples which themselves differed only slightly in colour. This work was carried out under artificial light in a GEC colour-matching cabinet.

It was a good demonstration of both the importance and the difficulty of testing for colour vision defects to see in another large room a display of many of the devices used for the purpose at different times. Besides the optical apparatus like the Nagel 'anomaloscope' and the colour-vision lanterns used by the railways and the mercantile marine, there were the 'confusion charts', typified by the Ishihara test cards and their modifications, and the arrays of samples used in the Munsell system and a number of similar 'colour atlases'.

In other rooms the visitors could see work being done by the new Optical Design Group. This group is concerned with the development of optical design methods, including work on automatic methods, using the University of London 'Mercury' computer, and on aberration theory. Research workers in optics from other establishments must have been envious of the well-equipped optical workshops, with their cutting, grinding and polishing machines and the apparatus available for inspection and testing. There was also the necessary equipment for the high-vacuum techniques involved in the deposition of thin films, such as anti-reflection coatings (blooming), aluminising, silvering and gold evaporation.

In yet other rooms work was in progress on optical image assessment, on bubble chamber optics and on particle sizing and counting, the last-named research being sponsored by the National Coal Board. Then in a room devoted to the study of the optics of fibres, Dr H. H. Hopkins was demonstrating a new and very sensitive cystoscopic camera.

In the vestibule there was an impressive array of books and scientific papers published by members of the Section and of bound copies of theses submitted by those students who had successfully completed research projects for the Diploma of the Imperial College (DIC) or for the MSC or PHD of London University. There were, in fact, no less than forty-five of these written during the last ten years.

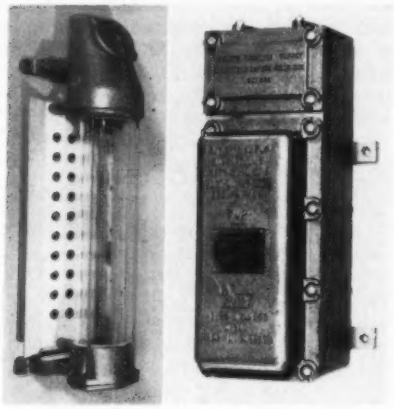
It had been planned that, after their tour of the laboratories and an adjournment for tea in the Staff Common Room, visitors should assemble in the Lecture Theatre to hear Dr Wynne's inaugural lecture on 'The Correction of Aberrations in Optical Systems'. Most unfortunately, Dr Wynne had an attack of influenza and this necessitated a change in the programme. At short notice Dr Wynne's senior research assistant, Dr R. N. Wilson, who had recently returned from Germany, described to an appreciative audience his 'Impressions of the Optical Industry in Germany'. As he had been for some time with the famous firm of Zeiss, his remarks could be taken as authentic and it was obvious that his experience would be of great benefit to the newly-formed group.

As Prof Wright was careful to mention in his introductory remarks, fine buildings do not by themselves guarantee a high standard for the work carried out in them. Nevertheless it was very gratifying to see the facilities now made available for study and research in all branches of technical optics. The Section has a fine record of achievement; the men who have built up that record, not infrequently under considerable handicaps, are still in charge and it is not too much to hope that their labours will be even more fruitful now that many of those handicaps have been removed.

NEW PRODUCTS

Flameproof Equipment

TWO DEVELOPMENTS in flameproof lighting equipment have been announced recently by Heyes and Co. One is a new 140w sodium fitting which is also weatherproof, making it suitable for use in outdoor areas where the explosion hazard is encountered, notably oil from roadways and oil tanker landing jetties. Designed to take a type SO



Left is seen the new Heyes flameproof weatherproof fitting for 140W sodium lamps and right, the flameproof ballast unit.

lamp, the unit gives an average output of 9,800 lumens for a lamp life of 4,000 hr. It is normally supplied in cast aluminium but is also available in cast iron and has one cable entry for either gland or conduit up to 1 in. The second development is of a flameproof ballast unit designed to house control gear either for the new fitting or for their well-glass unit when used with a 250w fluorescent bulb mercury lamp.

Heyes and Co Ltd, Wigan, Lancs.

New look for the 'Atlas Atlantic'

THE 'ATLANTIC' RANGE OF fluorescent fittings introduced by Atlas some four years ago have now been superseded by a new version, known as the 'Atlantic 2'. It retains the concept of a common spine to which a variety of attachments may be added but shows considerable improvements over the original. The chassis, available in single or double lamp versions in 4-ft, 5-ft and 8-ft sizes, is notably slimmer and is supplied completely pre-assembled, so that there is only one component to handle. It has a closed top, so profiled to ensure that screw heads do not project above the top surfaces thus giving perfect close mounting to ceilings. Other features of the spine include slide-in lamp holders which do not require fixing screws, keyhole-slot fixing of cover plate or reflector attachments, clip-on diffusers, snap-fit terminal blocks, side-of-chassis replacement of starter switches, and the use of welded studs to simplify gear replacement. There are four series of diffusers, of which the most notable is a 'two-tone' version in which a new extrusion technique has been applied to produce a diffuser with opal sides and clear base. There is also a version with opal polystyrene sides and ½-in. cell louver base. There are five series of reflectors. The remaining development of note is the use on all metal parts (including reflectors) of a new synthetic enamel finish 'Miracryl' having high surface hardness which offers good resistance to abrasion and to the penetration of dust and grit and high chemical resistance; it is also claimed to be superior to vitreous enamel in withstanding resistance to impact damage and chipping.

Mention should also be made here of a new twin-lamp circuit for 8-ft lamps which followed on the heels of the Atlantic announcement and makes use of this range's 8-ft spine. The circuit employs a new tube, rated at 85w and operating at a luminous efficiency of 81 lm/w, and a new, single low-loss control unit. The development represents an increase of 35 per cent in light output for equal electrical loading over the conventional twin circuit employing 5-ft 80w lamps, whilst giving a reduced lamp surface brightness. The increased light output means that, for a given installation of 5-ft 80w twin-lamp fittings, the same illumination can be produced from fewer of the new 'Super 8' fittings, thus reducing the total maximum demand on the supply system and the capital cost by significant amounts. Atlas claim, in fact, a 25 per cent saving on total annual lighting costs.

Atlas Lighting Ltd, Thorn House, Upper St Martin's Lane, London, WC2.

Three examples of Atlas 'Atlantic 2' fittings in twin-lamp versions: left, the basic spire; centre, angle reflector attachment; right, the 'two-tone' diffuser, with opal sides and clear base.

Translucent glass fibre sheeting

A NEW GLASS FIBRE MATERIAL suitable for use as a light controlling medium is announced by Cascelloid. The material, which has a high light transmittance, is finished smooth on one side and 'crystal' on the other, making for attractive decorative panels. The material is tough, and may be sawn, nailed, screwed, drilled and punched, or attached with a variety of fixings. It is supplied as a 33-in. wide sheet in lengths from 3 ft to 10 ft in 1-ft intervals.

Cascelloid Division, British Xylonite Co Ltd, Abbet Lane, Leicester.

Trade Literature

HOLOPHANE LTD, Elverton Street, London, SW1. Publication SL.960 gives brief technical information on two glass refractor bowls recently added to their 'Bi-Way' range.

PLASINTER CO LTD, Progress Works, Holyhead Road, Wednesbury, Staffs. New catalogue describing briefly the firm's variety of processes for depositing protective and decorative plastics coatings for all surfaces.

FALK, STADELMANN AND CO LTD, 91 Farringdon Road, London, EC1. Two recent publications are catalogue no. 819/60 describing industrial lighting fittings and a more general booklet dealing with their lighting service. Revised price lists have also been published.

COURTNEY, POPE (ELECTRICAL) LTD, Amhurst Park Works, London, N15. Comprehensive new catalogue on luminous ceilings, setting out, comp'ete with diagrams, details of components, design and construction of the firm's range of ceiling systems.

C. M. CHURCHOUSE LTD, Clarendon Works, Clarendon Cross, London, W11. The firm have introduced the German 'lighting bricks' into the country and a new publication, no. 189, describes the various shapes available.

MODERN ELECTRIC (INSTALLATIONS) LTD, 66-68 Brewery Road, London, N7. Usefully comprehensive reference book on the firm's 'Moderneon' illuminated signs, giving brief details of a few representative installations, data sheets on various designs of letter and a variety of type faces in which letters can be made.

OY STOCKMANN AB, Helsinki/Helsingfors, Vaihde 12 181 Växel. New catalogue for 1961, in Swedish and Finnish, detailing wide range of fittings (largely for incandescent lamps) developed by a number of international designers.

MISCELLANY

Personal

The architectural and town planning practice of Grenfell Baines and Hargreaves was merged on April 5 with the quantity surveying practice of Arnold E. Towler, to form one professional organisation known as Design Partnership. Founder partners of the new firm are GEORGE GRENFELL BAINES (senior partner), JOHN WILKINSON, ARNOLD TOWLER and WILLIAM WHITE. Mr Hargreaves has retired from the practice. All existing commissions will continue to be controlled by the present senior architect, quantity surveyor and direct partner interested. This is the first step towards realising the partners' long-term intention of creating a partnership covering all the professions connected with the design of buildings and physical environment generally. The inclusion of civil and structural, heating and ventilating and electrical engineers is planned for the near future and it is intended later to include landscape architecture and industrial design at partner status.

New president of the British Electrical and Allied Manufacturers' Association is Mr ANTHONY M. BROWNE, chairman and managing director of Hackbridge and Hewittic and chairman of Combined Electrical Manufacturers. Mr H. H. MULLENS, chairman and managing director of A. Reyrolle and chairman of C. A. Parsons, was elected deputy president.

Mr F. WIDNALL, previously manager and engineer of the AEI Lamp and Lighting Co's lighting equipment works at Hereford, has been appointed manager of the company's lighting engineering department and is moving to Leicester. He continues to be responsible for the lighting equipment engineering group at Hereford but is succeeded as manager there by Mr T. W. Grieve, previously technical and works manager for Williams and Williams Ltd.

Another change announced by AEI is that its north-west and north-east sales regions are now combined in a single, northern, sales territory. Mr G. W. NATTRASS, formerly manager of the north-east region, has been appointed manager of the new territory, with Mr F. C. TYRRELL, formerly manager of the north-west region, acting as deputy until his retirement in 1962. The assistant manager is Mr J. K. FRISBY. Mr Nattrass will retain his office at Leeds as the headquarters of the new region and the addresses of the company's area and other offices in the region remain unchanged.

It has been announced by Thorn Electrical Industries Ltd that Mr A. M. SCALES, previously Atlas area manager for Scotland, has returned to Thorn House to take up a new appointment as marketing manager for Atlas Lighting. He will be directly responsible to the general sales manager and his appointment will include control of the advertising and sales policy departments.

Overseas News

CELEBRATING ITS GOLDEN jubilee this year is the German lighting firm of Dr-Ing Schneider and Co, of Frankfurt, more usually referred to by its trade name DISCO. One of the founders, Dr-Ing John J. Schneider, is still active as senior president and part owner with the junior president, Mr Fritz Kalberlah, who joined the firm in 1950. The two in partnership have effected considerable extension of the business in the last few years, notably in building up an impressive export trade, and the firm's forward-looking attitude is reflected in their English catalogue, which could well serve as a model for any lighting catalogue.

TWO-DAY CONFERENCES on street lighting in Scandinavia were organised earlier this year in Oslo and Copenhagen and attended by about 200 representatives of municipal and road engineering interests. At each conference, local experts presented papers on streetlighting in its effect on accidents and as viewed by the police; there was also a paper on the proposals for a national street lighting code (presented in one venue by R. A. Aspestrand and in the other by I. Ovesen) which also reviewed the provisions of other national codes. Other papers included an account by I. Folcker (CIE President) of recent experiments on visibility on lighted streets in Sweden and an outline by Mr van Swet (deputising for J. de Boer) of recent theoretical work which led to a recommendation of a luminance of 2 cd/m² (about 0·6 ft-L) for important streets. Mr Smiatek from Germany presented a paper on the lighting of bridges and tunnels and Mr Waldram represented his APLE Conference paper, 'Surfaces, Seeing and Driving'. There was a lively discussion in both centres.

FOLLOWING THE RECENT announcement of a merger of the Wakefield Co and the Abrasive and Metal Products Co, T. D. Wakefield has been elected to the office of president and general manager of the latter firm's lighting subsidiary, the Art Metal Co. Other Wakefield officials have also been appointed to posts in Art Metal, together with new appointments of Art Metal personnel.

AMERICAN VIEWS ON LIGHTING for sports are now published in a new booklet, 'Current recommended practice for sports lighting' just issued by the American IES and reprinted from the February issue of *Illuminating Engineering*. The new document covers a wide variety of sports, ranging from major professional team games to recreational and playground activities. Introductory chapters discuss the general purpose and scope of lighting for sports and factors of good illumination for such areas. Lighting requirements from the standpoints of players, spectators and commercial interests follow, then descriptions of lighting equipment and systems to meet these requirements, including recommended layouts of equipment, and a guide to efficient maintenance. Copies may be obtained from the Society at 1860 Broadway, New York 23, New York, at prices ranging from 50c to 35c depending on the quantity ordered.

Industrial Notes

TEN MEMBER FIRMS of the Decorative Lighting Manufacturers' Association are participating in an exhibition at the Old Swan Hotel, Harrogate, from May 29 to June 1, for the purpose of showing their autumn collections. The Association states that it hopes this will be an annual event, seeing it as the first serious attempt to establish a basis for a lighting Fair.

AS MADE CLEAR in our editorial comment in the April issue, the Government is not prepared to authorise the Road Research Laboratory to undertake a pilot scheme on the lighting of motorways. This announcement came as the answer to a question put by Mr Charles Royle, to which the Minister of Transport replied: 'I see little practical advantage in having a pilot scheme since it is not my present intention to light rural motorways while heavily-trafficked all-purpose roads—where the hazards from pedestrians, cyclists, general traffic movement and obstructions are greater—remain unlighted.' In another place, the Lords were concerned about the diversity of traffic-sign and vehicle lights, which, it was suggested, led to accidents and confusion on the road. Lord Chesham, Joint Parliamentary Secretary to the Ministry of Transport, said that the type of lights carried by vehicles was determined part by regulation and part by arrangements between manufacturers and they were moving in the direction of uniformity. The Ministry was about to circulate for comment a proposal to require all bicycles to carry rear lamps marked with the number of the relevant British Standard and also revised requirements for direction indicators.

INCREASED EFFICIENCIES for 'Osram' 8 ft. 125 W warm white and white fluorescent tubes are announced by the GEC, who claim that, with outputs of 9,000 lm (initial) and 8,250 lm (subsequent through life), these lamps have the highest light

output of any European-made tube. The improvements result from the application of two processes exclusive to the firm; one is a powder classification system which makes it possible to select only those particle sizes with the greatest efficiency, the other is a water soluble binder process in which the selected particles are deposited on the tube wall in such a way as to secure the maximum conversion of ultra-violet energy to visible light. The tubes are to become commercially available from July 1, price 16*s*. The same firm announces the availability, from March 27, of a 'mushroom silverlight' g.l.s. lamp of 40w rating, priced at 1*s*. 8½*d*.

Cover Picture

This month's cover picture, of St. John's Church, Hatfield, illustrates a modern building of distinctive style, in which the lighting system of Holophane concentrating reflector units concealed in the roof illuminates ceiling panels on the south side only which diffuse and reflect the light over the whole seating area. The architectural design and the treatment generally of the interior, executed by Peter Bosanquet, Lionel Brett and Kenneth Boyd, results in a most pleasing environment, whilst maintaining an atmosphere conducive to worship.

Situations

Vacant

Building Research Station, Garston, Watford, Herts, requires EXPERIMENTAL OFFICERS and ASSISTANT EXPERIMENTAL OFFICERS for research on lighting principles and design. Programme ranges from study of basic principles of visual efficiency and comfort to practical problems of design of artificial lighting and daylighting techniques, and design and testing of new lighting ideas in specific buildings. Ability to design apparatus and prototype lighting devices necessary; experience in photometry and illumination theory desirable. Quals: HNC, Diploma in Technology or pass degree in science or engineering, or IES Diploma with good A-level educational background; AEO age 22 or over, EO min age 26. Starting pay: AEO, £625 (age 22)—£776 (age 26) to £957; EO in range, £1,057 to £1,296. Forms from Ministry of Labour, Technical and Scientific Register (K), 26 King Street, London, SW1, quoting D. 154/1A. Closing date May 15, 1961.

LIGHTING ENGINEER/PLANNER required by leading lighting fittings manufacturer, capable of preparing interior lighting, designing, estimating, surveying, etc. Age 22-28, salary depending on age and experience. Write Box No. 729

LABORATORY MANAGER. Physicist (preferably under 40) required to take charge of research, development and routine work in the photometry and general laboratories of Holophane Limited. Some familiarity with techniques of measurement of light and heat is desirable. Successful applicant will be expected to maintain personal contact with clients, technical associations and manufacturers, involving some travel. Company pension scheme. Applications, which will be treated in confidence, should be made fully in writing to the Technical Director, Holophane Limited, Elverton Street, London SW1.

LIGHTING SALES ENGINEER. Experienced man having proven sales record and good connection with users, architects and consultants required in East Midlands area. Short period of training will be given at head office in London, and successful candidate should have some technical experience. IES diploma membership advantageous. An opportunity for a youngish man to build his future in a happy old-established organization. Car provided and expenses. Contributory Pension Fund. Apply with full details of experience, etc. (marking envelope 'Confidential') to Box No. 730.

ENGINEERS

Lighting (London)

We have a place for a young man or woman with aptitude for Decorative and Display aspects of lighting, able to execute small sketches of lighting items and environments; basic knowledge of Lighting Engineering. Ref. LE/1.

Additional places available for Lighting Engineers, 20/25 age group. Minimum qualifications, C. & G. Intermediate, preferably finals, and able to compute lighting schemes in accordance with new I.E.S. Code from basic data provided by Photometric Section. Suitable applicants will be trained for eventual Technical Representation. Ref. LE/2.

Please state education, experience and salary required, quoting appropriate Ref., to:

Chief Lighting Engineer,
'FALKS',
Dept. 'A',
91 Farringdon Road,
London, E.C.1.

WE ARE LOOKING FOR

Britain's Top lighting Designer

For the most important job in the lighting industry. He will be expected to develop quickly fluorescent lighting fittings of all types and with the materials they incorporate, the techniques they employ and the sales appeal they enjoy, lead the lighting industry in this country for many years to come.

He will be capable of complete liaison with both marketing, research and production resources and will develop and control his own design and engineering unit.

He will be working for a company whose technical, production, sales and development organisations are known throughout the world.

WRITE TO BOX No. 728

Postscript

IN THE HIGHLANDS OF SCOTLAND, so I am told, there are families where the grandparents speak nothing but Gaelic, the parents speak both Gaelic and English, and the children speak only English. Such is the transition caused by compulsory education. The IES may well be going through a similar transition, propelled if not compelled by the march of the affluent state. The new Code lists glare indices side by side with levels of illumination—will the next edition leave out the lumens? The validity of the new levels rests even less on experiment than did that of the earlier editions, and much more on a firm belief that they represent the 'rate for the job' by general consensus of opinion and, where possible, experiment as well. I believe it to be a real step forward that the new Code says so, boldly and frankly, rather than hitching the recommendations to an experimental procedure as open to criticism as that adopted by our friends on the other side of the Atlantic. But clearly it matters very little whether we have 20 or 30 lm/ft² in a general office; what is far more important is whether or not the level, whatever it may be, has been provided free of troublesome glare and discomfort. This is what the new Code brings right out. A radical departure from convention, as this new Code certainly is, will necessarily have its teething troubles. The drafting committee are reputed to have considerable experimental data derived from extensive field studies to back up their recommendations, but clearly this will not cope with all problems raised by difficult cases. Users of the Code will certainly help by bringing such problems forward in a constructive manner so that future editions can eliminate errors and effect improvements. I understand that the Building Research Station, upon whose work much of the new Code is based, is prepared to act as a clearing house for these problems, but I imagine that the IES Technical Committee is the proper body to which to direct them in the first place.

DECIMALISATION IS MUCH IN THE NEWS AT THE MOMENT. We are all being urged to consider a changeover to decimal coinage, which those of us who have spent any time abroad probably feel to be a good thing to do. Decimalisation is, however, not the same thing as the adoption of the metric system, which is also under discussion, as it has been for over 150 years. As I cannot think of any technical discipline with a more confusing system of units than lighting, it might well be good for us to make a change to metric units before things get worse than they already are. I admit that, since our buildings are still measured in feet and inches, we would have our difficulties, but I am sure they could be overcome with less trouble than we have at the moment with candelas per square inch, apostilbs, lamberts, foot-lamberts and nits. By doing so we would solve at one go the foot-candle *vs* lumen-per-square-foot argument—our illumination levels would all be in *lux*.

I AM TOLD, though I cannot vouch for the truth of the story, that the authorities do not intend to light the motorways, despite the reasoned case put forward, notably by Mr Waldram in his paper to the IES last December, that there should be good continuous street lighting along their whole length. I have heard it suggested that the case was weakened by the claim that we should be able to see well enough to drive at a speed of 75 m.p.h. at night, this speed being necessary in order that the full financial benefit, in saving of time, should be extracted from the motorway. Such a speed, it is argued, is dangerous even in good street lighting, but is in fact neither desirable nor necessary, because the heavy lorries, which constitute the traffic having the greatest economic influence, travel at no more than 50 m.p.h. It is further said that if they find in North America, where they have many years of experience of motorways, that a night time speed limit of 50 m.p.h. has to be set and strictly enforced, we should profit by their experience, particularly as traffic density on our motorways at night is higher than that on the majority of American roads. If this argument is valid, the case for full street lighting is less good, but there does seem to me to be a case for the reduced street lighting with long spacing proposed and tried out by the Road Research Laboratory on the Colnbrook By-pass. This experimental system, which received rather less attention than it deserved, was designed to be used with headlights. The road lights marked the way and dispelled dangerous shadows, and also greatly mitigated the glare from oncoming headlights. I believe that with this type of lighting the safety of the motorway at night could be increased, and I hope the authorities will give it further consideration now that we know more about traffic conditions at night on the motorway. It may well be another instance of a typical British compromise which is designed to be expedient, but which in the event proves to be right.

PROBABLY IN COMMON WITH MANY OTHERS who were there at its opening, I came away from the Electrical Engineers' Exhibition at Earl's Court in March with somewhat mixed feelings. Although some of the stands themselves showed improvements in design and there were some interesting new products to be seen, I had the feeling that there were fewer lighting exhibits this year. Having only the first morning to look around I was appalled at the state of unreadiness at the official opening hour. Many of the stands were incomplete (due, I believe, to a strike of carpenters) and the gangways were cluttered up with debris left by the stand contractors—hardly a suitable welcome for the member of the government who came to open the exhibition. Compliments are due for the novelty of the lighting 'gimmick' in the foyer, but not for the glare from the projectors, particularly noticeable in walking down the short flight of stairs from the exhibition hall.

BACK IN FEBRUARY I asked if anyone could help me to resolve the puzzle put to me by a friend who could not fathom why he saw his reflection in a mirror reversed from left to right but not upside down. This provoked a suggestion from Professor Wright that the solution would be found by standing at the edge of a still pond and looking down. I passed this suggestion on. I had a reply. 'Alas, your professor, who must be young and thin, fails to appreciate what obstacles are put in the way of his experiment by bifocals and years of gluttonous living. But at least I can see his point.'

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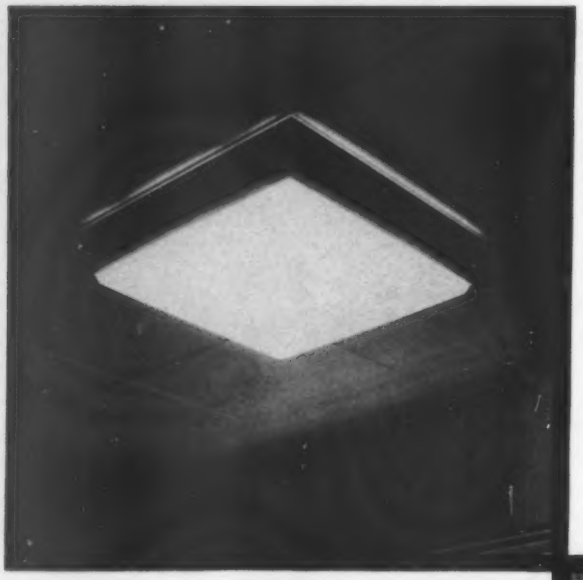

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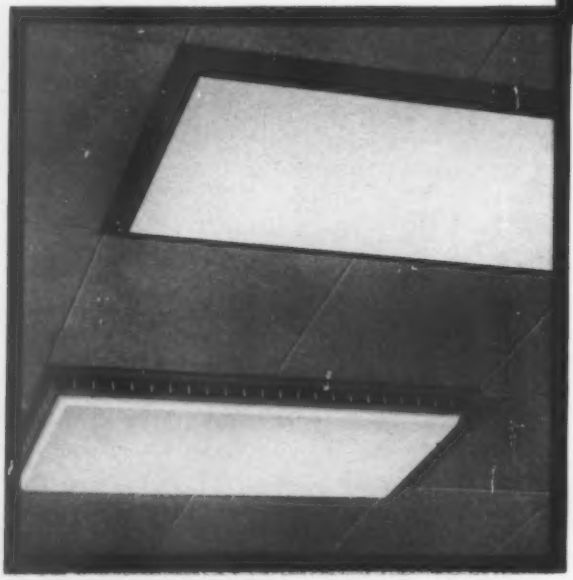

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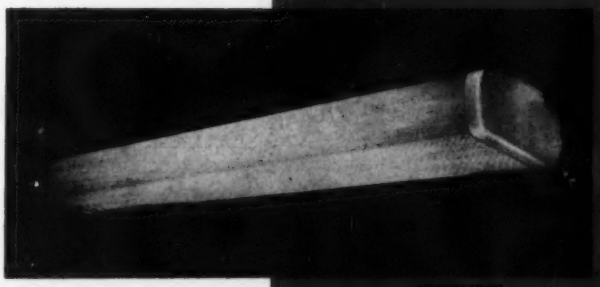

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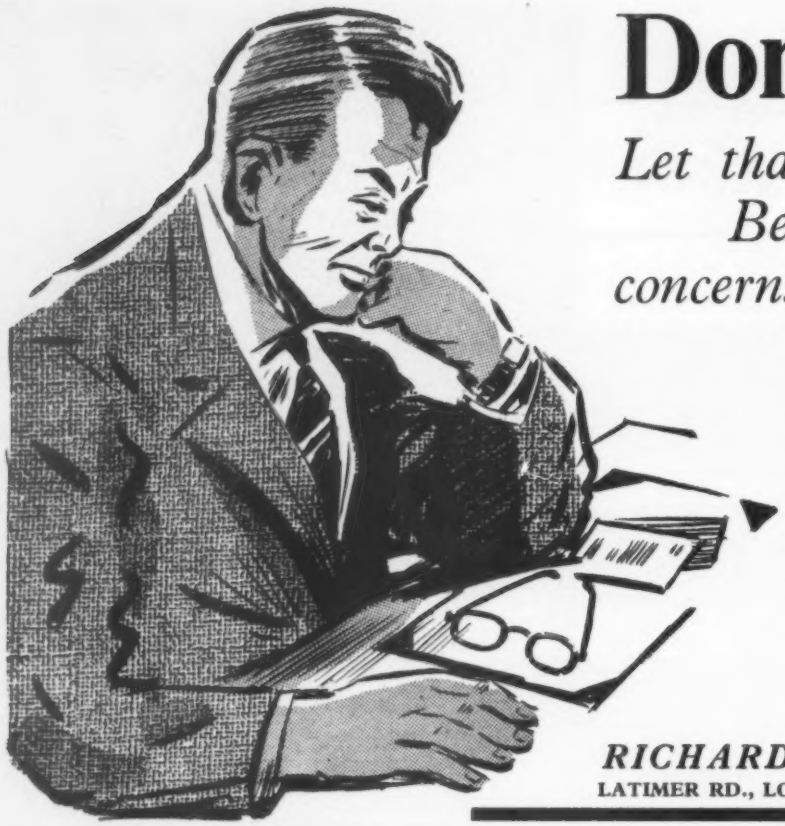

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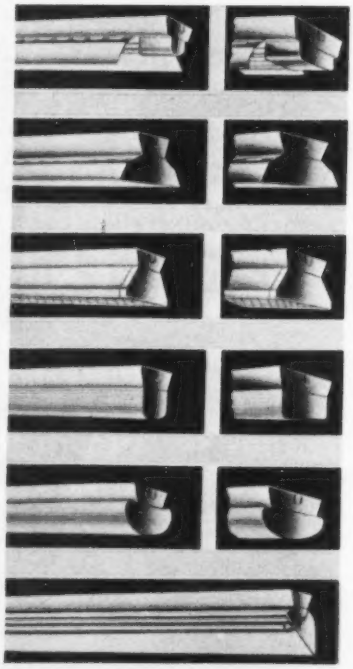

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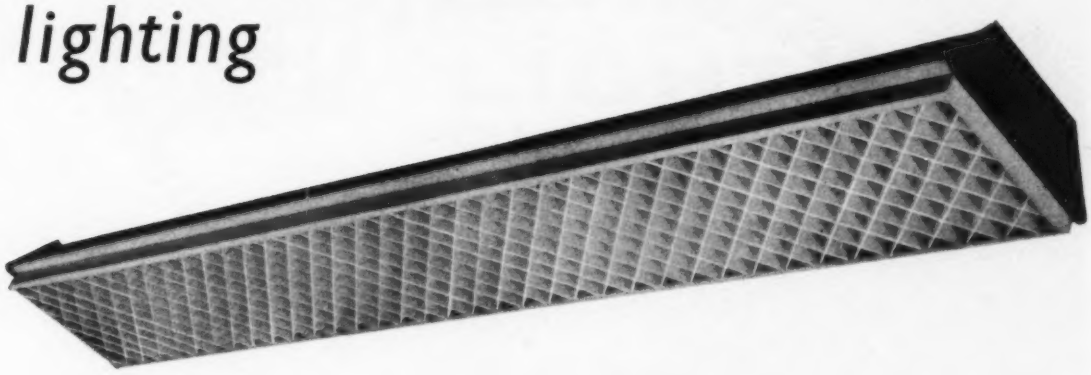

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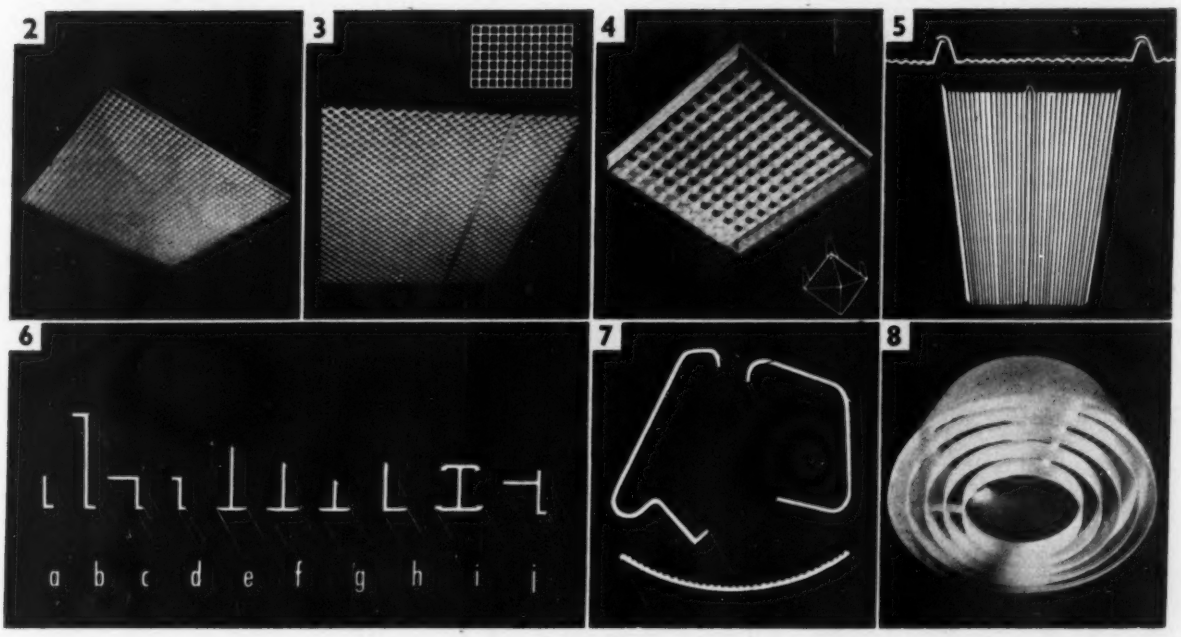

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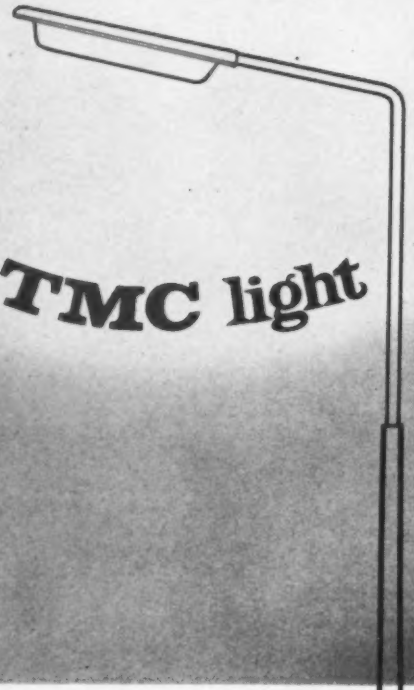

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18 μF	3⅞	3 × 2
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25 μF	4¼	3 × 2
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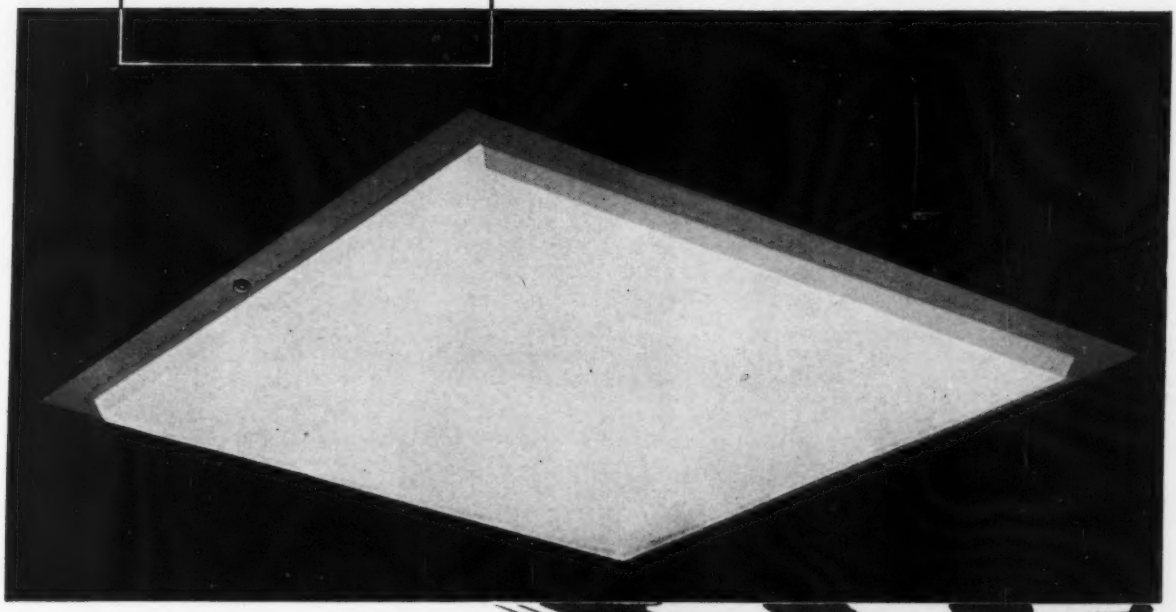

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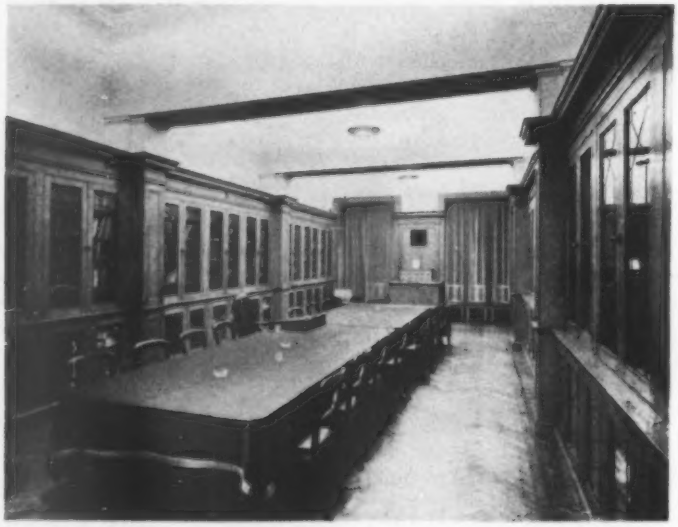

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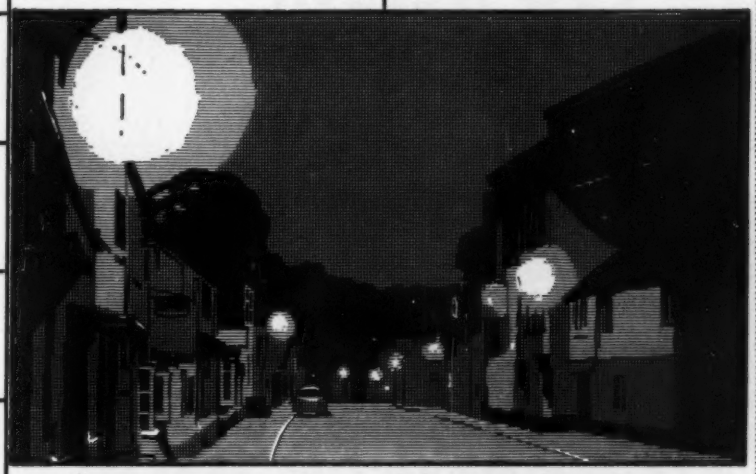
SHOP WINDOW LIGHTING		
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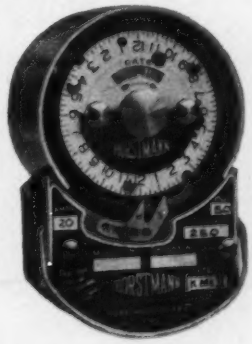

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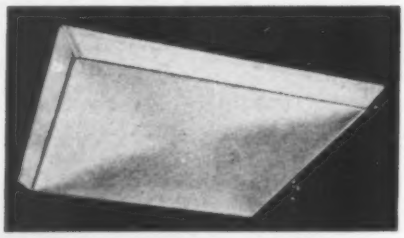

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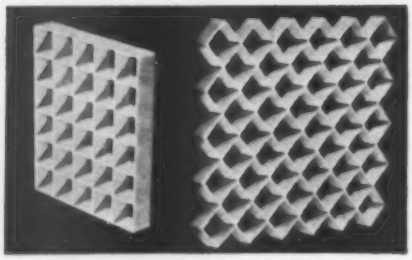

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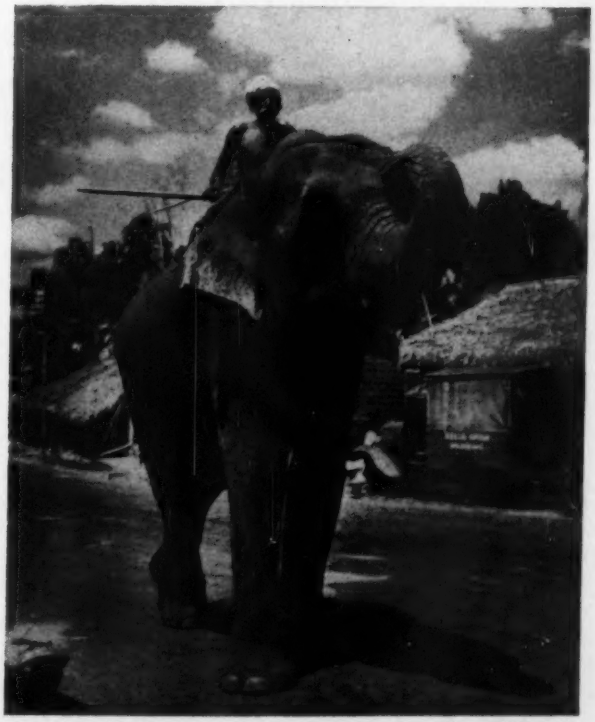

Service by Elephant, Ceylon *(Photo J. Allan Cash)*

INDEX TO ADVERTISERS

	Page
A.E.I. Lamp and Lighting Co. Ltd.	i
Atlas Lighting Ltd.	iii
Benjamin Electric Ltd.	xv
Cryselco Ltd.	xxv
Ekco-Ensign Electric Ltd.	xxi
Elco Plastics Ltd.	xix
Eleco Ltd.	iv
Falk, Stadelmann and Co. Ltd.	ix
General Electric Co. Ltd.	x, xi
G.V.D Illuminators	xxii
Hailwood and Ackroyd Ltd.	cover ii
Harris and Sheldon (Electrical) Ltd.	viii
Holophane Ltd.	cover iv
Horstmann Gear Co. Ltd.	xxiii
A. H. Hunt (Capacitors) Ltd.	vi
Imperial Chemical Industries Ltd. (Plastics Division)	cover iii
Lumitron Ltd.	xxiv
Major Equipment Co. Ltd.	xviii
Philips Electrical Ltd.	v
Revo Electric Co. Ltd.	xvi
Richard Daleman Ltd.	xviii
Satchwell and Gittings Ltd.	xxiv
Shell Chemical Co. Ltd.	xiv
Simon Engineering Dudley Ltd.	xxvi
Stanton Ironworks Co. Ltd.	vii
Strand Electric and Engineering Co. Ltd.	xii
Telephone Manufacturing Co. Ltd.	xx
Tubewrights Ltd.	xiii
Wardle Engineering Co. Ltd.	ii
Wokingham Plastics Ltd.	xvii

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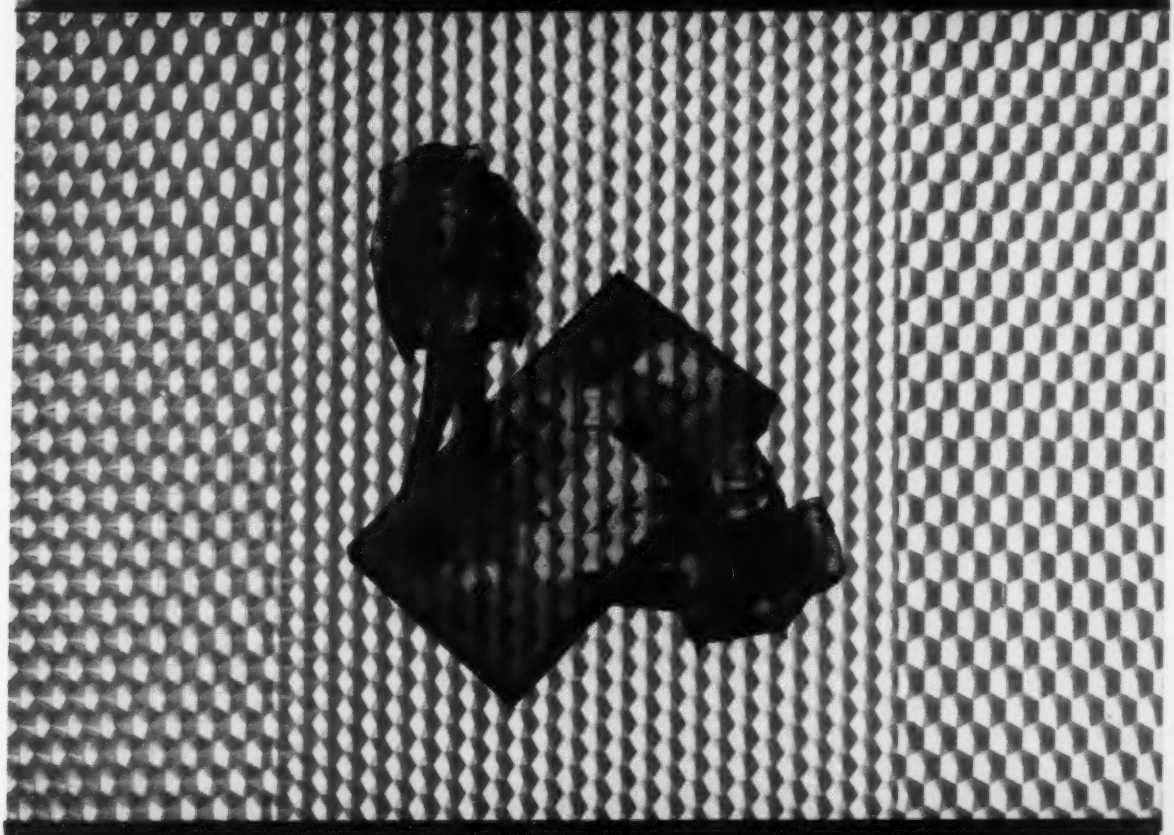
IF FLUORESCENT TUBES COULD ONLY SEE . . .



they might find themselves peering down through this while their progeny, the little lumens, become white with heat. For confinement to precise lines of conduct is enough to make any lumen glow.
Holophane, through their scientific systems of prismatic control, bring to fluorescent lighting a unique approach where brightness is controlled and high utilization of light sources is achieved. Light is where you want it—on the working plane—and not in the eyes. Write for latest Holophane lighting catalogues, without obligation.

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'Perspex' acrylic sheet for modular ceiling lighting fittings

Modular fittings with opal 'Perspex' diffusers meet the lighting requirements of modern office blocks with low ceiling heights. The diffusing covers of modular fittings are often large and must be designed so that they do not sag. Studies on the "creep" properties of 'Perspex' provide the necessary data to ensure trouble-free operation over very many years.

Equipment used at the T.S. & D. Department, I.C.I. Plastics Division, to measure the "creep" characteristics of 'Perspex' acrylic sheet.

'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

Modular ceiling lighting fittings with opal 'Perspex' diffusing panels made by The General Electric Company Limited, installed in the Midland Bank Ltd., High Holborn.

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